

**National Aeronautics and
Space Administration**

Research Announcement

**Research Opportunities
in
Space Life Sciences**

**Advanced Human Support
Technologies Program**

1996

**A Research Announcement for the
Life Sciences Division**

Letters of Intent Due: February 28, 1997
Proposals Due: April 1, 1997

**NASA Research Announcement
Soliciting Proposals
for
Research Opportunities
in
Space Life Sciences**

**Advanced Human Support
Technologies Program**

NRA 96-HEDS-05
Issued: December 27, 1996
Letters of Intent Due: February 28, 1997
Proposals Due: April 1, 1997

Life Sciences Division

**Office of Life and Microgravity Sciences and Applications
National Aeronautics and Space Administration
Washington, DC 20546-0001**

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**Research Opportunities in
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**Advanced Human Support
Technologies Program**

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NASA Research Announcement

Research Opportunities in Space Life Sciences

Advanced Human Support Technologies Program

This National Aeronautics and Space Administration (NASA) Research Announcement (NRA) solicits proposals to participate in research opportunities in the Advanced Human Support Technologies (AHST) Program of the Space Life Sciences Division. This Announcement solicits research proposals that support the opening of the space frontier by exploring, using, and enabling the development of space and by expanding human experience in space. In consonance with NASA's fundamental mission and the Human Exploration and Development of Space (HEDS) Strategic Plan, research supported by the Life Sciences Division will increase knowledge of nature's processes using the space environment, aid in the exploration and settlement of the Solar System, support the achievement of routine space travel, and enrich life on Earth through the use of space technology and application of biomedical knowledge.

The major means that the Life Sciences Division will employ in supporting these goals are scientific research and technology development using space platforms, such as the Space Shuttle and the International Space Station, and ground facilities. The specific research and technology development elements of the AHST Program that are included in this Announcement are Space Human Factors Engineering, Advanced Life Support, and Advanced Environmental Monitoring and Control. Proposals submitted in response to this Announcement may be for ground-based research investigations or for limited types of space flight experiments designed for the Shuttle middeck or for the earliest phase of utilization of the International Space Station. Proposals may be for activities lasting up to three years and beginning in FY 1998. Proposals to conduct ground-based research aimed at developing mature experiments for flight are particularly encouraged.

This Announcement will be updated and issued annually and will be the primary means of obtaining research and technology proposals from the space life sciences and technology community. This Announcement is restricted to the science and technology programs named above and described in detail in Appendix A. Potential proposers should read the program descriptions that are of interest with care and focus their proposals on the specific research emphases defined in this Announcement.

Participation in this Announcement is open to all individuals and all categories of domestic and foreign organizations, industry, educational institutions, other

nonprofit organizations, NASA laboratories, and other government agencies. Proposals that will enhance or complement the scientific return from research currently being supported by the National Institutes of Health, the National Science Foundation, or other government agencies are encouraged. In addition, proposals to advance relevant technology and develop practical applications of NASA-developed technology are sought under this Announcement.

Because of the severe limitations of access to flight opportunities, it is expected that the vast majority of proposals approved in response to this Announcement will be for ground-based research. Proposals for flight experiments are very competitive and should be based on solid ground-based research findings. A letter of intent to propose is requested by February 28, 1997. Proposals may be submitted at any time up to April 1, 1997.

Proposals will be evaluated by an independent peer-review panel for overall scientific or technical value and cost. Relevance to NASA's programmatic needs and goals and the feasibility of implementation will be evaluated separately by NASA. A selection announcement will be made between October and November of 1997, pending budget availability. Funding of selected proposals will begin sometime between October, 1997 and September, 1998.

Further details relevant to this program are included in the attached appendices and the associated companion document. Appendix A provides relevant technical information applicable only to this Announcement. Appendix B contains the basic guidance needed for the preparation of solicited proposals in response to this Announcement. Appendix C contains detailed instructions and the required application forms. The document titled *Space Life Sciences Standard Companion Document 1996* describes the evaluation process to be used, special ground facilities available for use by proposers, the experiment accommodations provided in the middeck of the Shuttle and on the International Space Station (ISS) during the earliest utilization phase, and the space flight equipment that may be available to support these opportunities

The following items apply only to this Announcement.

Solicitation Announcement Identifier:	NRA 96-HEDS-05
Number of Copies Requested:	Original + 20 copies
Letters of Intent Due:	February 28, 1997
Proposals Due:	April 1, 1997

Selecting Official:

Director
Life Sciences Division
Office of Life and Microgravity
Sciences and Applications

Obtain Additional Information From: the appropriate Program
Coordinator, as indicated in the table
below, at the following address:
UL/Life Sciences Division
NASA Headquarters
Washington, DC 20546-0001
Telephone: (202) 358-2530
Fax: (202) 358-4168

Program Element	Program Element Coordinator
Space Human Factors Engineering	June Ellison
Advanced Life Support	Guy Fogleman, Ph.D.
Advanced Env. Monitoring & Control	Darrell Jan, Ph.D.
Flight Experiments	Peter R. Ahlf

Proposals and Letters of Intent mailed through the U.S. Postal Service by express, first class, registered, or certified mail are to be sent to the following address:

Information Dynamics, Inc.
SUBJECT: NASA Life Sciences Research Proposal
300 D Street, SW
Suite 801
Washington, DC 20024.

Special instructions apply to foreign (non-U.S.) proposals. In addition to sending the original (signed) proposal and twenty (20) copies to NASA through Information Dynamics, Inc., as directed above, **one (1) additional copy along with the Letter of Endorsement from the sponsoring agency or organization must** be forwarded to:

Ms. M. Ruth Rosario
IH/Space Flight Division
Ref: NRA 96-HEDS-05
NASA Headquarters
Washington, DC 20546-0001
USA

Proposals and Letters of Intent hand delivered or sent by commercial delivery or courier services are to be delivered to the above addresses between the hours of 8:00 AM and 4:30 PM.

The telephone number (202) 479-2609 may be used when required for reference by delivery services. Information Dynamics, Inc. (IDI) cannot receive deliveries on Saturdays, Sundays, or federal holidays.

Letters of Intent (only) may also be submitted electronically via e-mail to the following addresses:

loi@hq.nasa.gov

Following receipt of a proposal by IDI, a postcard will be sent to the proposer confirming receipt of the proposal and notifying the proposer of any missing information that is required prior to review.

The government's obligation to make awards is contingent upon the availability of appropriated funds from which payment for award purposes can be made and the receipt of proposals that the government determines are acceptable for award under this NRA. It is anticipated that awards averaging \$125,000 (total costs) each annually will be made, although the total annual cost may vary from \$15,000 to \$350,000. Your interest and cooperation in participating in this effort are appreciated.

Original Signed by

Arnauld E. Nicogossian, M.D.
Acting Associate Administrator for
Life and Microgravity Sciences and Applications

**ADVANCED HUMAN SUPPORT
TECHNOLOGIES PROGRAM**

I. Introduction

The Life Sciences Division of the National Aeronautics and Space Administration (NASA) seeks proposals for the Advanced Human Support Technologies (AHST) Program in support of the Human Exploration and Development of Space (HEDS) Enterprise. This Announcement and the companion Announcement “Gravitational Biology and Biomedical Research and Countermeasures Programs”, NRA 96-HEDS-04, summarize the Life Sciences Division’s research programs in Space Life Sciences and are the two-part solicitation used to obtain scientific and technical proposals to be funded during Fiscal Year 1998, either for new research or for the continuation of research beyond the term specified in a previously funded proposal. Other Announcements calling for focused research or utilization of unique resources may be issued throughout the year. Unsolicited proposals received at other times during the year will be held until the next annual review period if the proposed research is relevant to the programs described in this Announcement. Proposals outside of the research and technology development emphases defined in this Announcement will, in most cases, be rejected or returned to the proposer. However, NASA reserves the right to act in the best interests of the federal government in the matter of proposal acceptance and evaluation.

This Appendix describes the types of proposals that are acceptable for submission in response to this Announcement, defines the technology development programs within the scope of this Announcement, and describes the current areas of technology development that proposals should address. In addition, this Appendix includes guidelines for preparing and submitting proposals and defines the administrative policies governing the program and grantees.

The goal of the Human Exploration and Development of Space (HEDS) Enterprise is to “enrich life on Earth through people living and working in space.” Individuals participating in NASA’s Space Life Sciences Division programs are encouraged to help foster the development of a scientifically informed and aware public. The Space Life Sciences Division programs represent an opportunity for NASA to enhance and broaden public knowledge, understanding, and appreciation of life sciences research and of the value of research in the space environment. Therefore, all participants in this NRA are strongly encouraged to promote general scientific literacy and public understanding of life sciences, the space environment, and the Space Life Sciences

programs through formal and/or informal education opportunities. Where appropriate, supported investigators will be required to produce, in collaboration with NASA, a plan for communicating their work to the public.

II. Proposal Types

Proposals should address one or both of the following:

1. Ground-Based Research Investigation

It is expected that the majority of proposals submitted in response to this solicitation will fall into the category of standard technology development proposals, i.e., proposals to carry out a technical study in an Earth laboratory and having a clearly defined set of technical objectives relevant to NASA's mission. All proposals must be consistent with the AHST Program elements and areas of element emphasis described in this Announcement if they are to be considered for funding. In addition, all proposals must be consistent with the goals of NASA's Human Exploration and Development of Space (HEDS) Enterprise. Proposals to conduct ground-based research leading to the development of technologies for testing and evaluation during the later phases of the International Space Station utilization (from 2001 onward) are particularly encouraged. Some proposals may require special NASA Earth-based facilities for their completion (see Section 4, *Space Life Sciences Standard Companion Document 1996* for a description of special NASA facilities). Proposers should contact pertinent NASA centers to arrange for access to the facilities prior to submitting their proposal.

2. Space Flight Experiment

Flight experiments will be accommodated on whichever carrier is best suited to the execution of each experiment. Proposals are sought to carry out one of three special types of scientific and technical studies in space: (1) short-duration experiments that can be implemented primarily on the Shuttle middeck without the use of major mission resources, (2) long-duration experiments that can be implemented with the limited resources available on the International Space Station (ISS) during the early assembly phase (1999-2001), and (3) "pre- and post-mission" studies involving testing of the astronaut crew prior to and on return from their space mission.

Space studies proposed for the Space Shuttle or ISS are severely constrained by limitations on resources such as weight, power, and crew time and by the availability of flight hardware (Section 3, Standard Companion Document). Proposals requiring resources beyond the capabilities defined in this Announcement and the

Standard Companion Document should not be submitted in response to this Announcement.

Though it is recognized that flight proposals may, and often must, include ground-based research, flight investigations must represent mature studies strongly anchored in previous ground-based research and/or previous flight research (see Section IV of this Appendix).

Regardless of proposal type, every proposal should focus on at least one of the three technology development AHST program elements defined in the next section and should be relevant to the goals of the HEDS Strategic Plan cited in Section VII (Bibliography) of this Appendix. A proposal may be multidisciplinary or interdisciplinary, involving combinations of these technology development elements but, if this is the case, that fact should be stated clearly at the beginning of the proposal. Proposals should include a well-defined development plan which can be accomplished within three years or fewer.

NASA has a strong commitment to the ethical treatment of human and animal research subjects, and assurance of compliance with federal regulations regarding human subjects and/or animal care and use is required as part of the proposal submission process (see the “Special Matters” instructions in Appendix C of this Announcement). **Potential applicants should note that review of a proposal will not be undertaken if the required information is not supplied.**

This Announcement solicits science and technical proposals, based upon sound principles, that are highly innovative even though they may contain some risk of failure. Bold, novel approaches to solving technology needs are encouraged. At an appropriate point in the development of these technologies and after suitable evaluation, the appropriate NASA field center will become increasingly involved in the technology development, in order to ensure that requirements for future use are being addressed in the technology development effort. Finally, technologies advancing to a near flight-ready stage will be tested first in integrated ground-based systems and then in flight as appropriate to ensure their efficacy prior to becoming incorporated into flight experiments or flight systems.

Proposers are required to include a projection showing the time frame for the anticipated use of their technology in flight systems in all proposals to this NRA. This requirement is not by any means meant to favor near-ready technologies over concept-level, high-risk technologies, but rather to stimulate creative, innovative ideas for incorporating new technologies into flight systems as early as possible. In fulfilling this requirement, proposers are encouraged to refer to Program Plans as available and to contact appropriate NASA field center personnel when possible.

III. Advanced Human Support Technologies (AHST) Program

The mission of the Human Exploration and Development of Space (HEDS) Enterprise is to open the space frontier by exploring, using, and enabling the development of space. In using space, the Enterprise will develop the tools and skills to live and work there, to take advantage of its unique environment for conducting research in science and engineering, and to generate technology. In the long term, the goals of the Enterprise are to:

- Understand and use nature's processes in space
- Explore and settle the solar system
- Achieve routine space travel
- Enrich life on Earth through people living and working in space.

As related to NASA's Human Exploration and Development of Space Enterprise, the major goals of NASA's Life Sciences Division, located within the Office of Life and Microgravity Sciences and Applications, are to:

- Develop the scientific and technological foundations for a safe, productive human presence in space for extended periods and in preparation for exploration
- Apply this knowledge and technology to improve our nation's competitiveness, education, and the quality of life on Earth.

To accomplish these goals, the Division supports research and technology development activities in three distinct but related programs: Gravitational Biology, Biomedical Research and Countermeasures, and Advanced Human Support Technologies (AHST). This Announcement is concerned only with the AHST Program. The companion Announcement, *Research Opportunities in Space Life Sciences: Gravitational Biology and Biomedical Research and Countermeasures Programs* (NRA #96-HEDS-04) should be consulted for additional opportunities.

The and Advanced Human Support Technologies Program contains three elements (see Figure 1): Advanced Life Support, Advanced Environmental Monitoring and Control, and Space Human Factors Engineering. In the remainder of this section, the AHST program elements supported by the Division are defined and their specific emphases for the 1998 fiscal year (October, 1997 to September, 1998) are specified. **It is important that the prospective investigator read the relevant section(s) carefully, as many of the programmatic emphases are different from those appearing in previous Life Sciences Division NASA Research Announcements.**

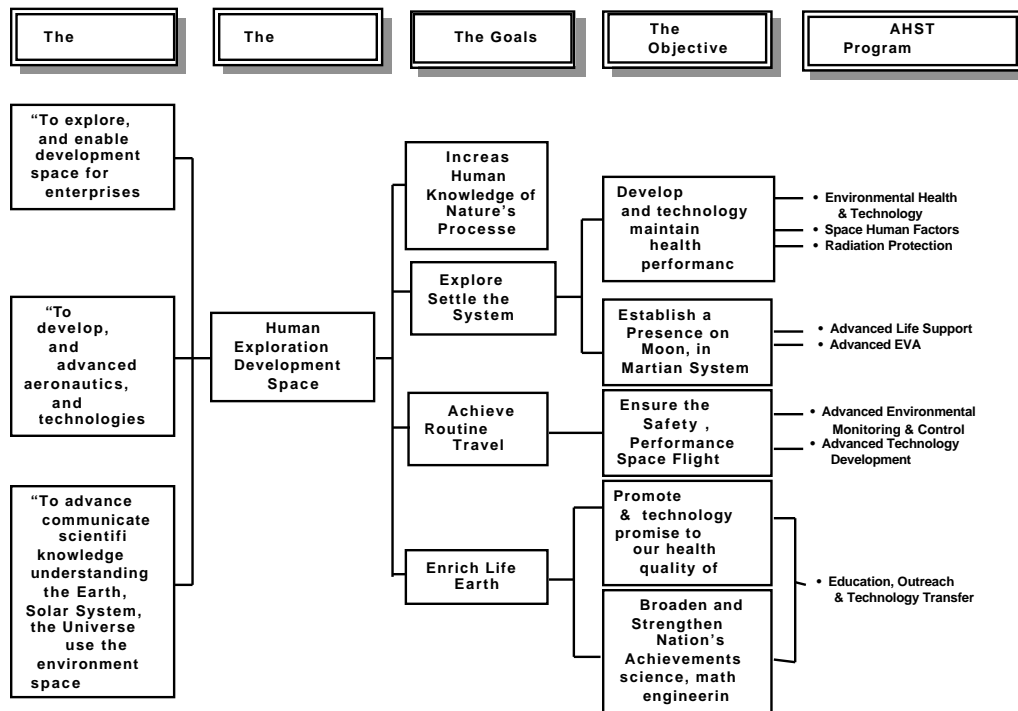


Figure 1. Relationship of the Advanced Human Support Technologies Program to the NASA/HEDS Strategic Plan

A. Space Human Factors Engineering

Element Description

The Space Human Factors Engineering (SHFE) element of the Advanced Human Support Technologies (AHST) Program is designed to integrate knowledge about human capabilities and system engineering methodologies into space craft design, mission planning, and related ground operations. The Program also develops new processes and procedures; draws on human factors expertise in aeronautics to optimize crew training, automated systems design, proficiency and productivity; and uses relevant analog studies in simulators as well as in extreme and isolated environments. The emphasis in this NRA is on SHFE. The Behavior and Performance element is addressed in *Research Opportunities in Space Life Sciences: Gravitational Biology and Biomedical Research and Countermeasures Programs* (NRA #96-HEDS-04).

This element supports both scientific and technical activities. Potential applicants should refer to Section V (part A, 2nd paragraph) of this appendix for definitions of scientific and technical activities. The primary focus of this element is to extend the benefits of human factors research to space operations in accord with NASA's Strategic Plan, titled *NASA's Enterprise for the Human Exploration and Development of Space*.

The SHFE element is organized around four major goals, each representing a distinct focus. These goals are to:

- Expand knowledge of human physical capabilities and limitations in space
- Develop cost-effective technologies that support integrating the human and system elements of space flight
- Use human factors research results and technology developments in mission planning to increase mission success and crew safety
- Make NASA technology available to the private sector for Earth applications.

Element Emphases for FY 1998

To be considered for funding in FY 1998, scientific and technical proposals for fundamental research should be directed toward one or more of the following objectives:

- Identifying and defining SHFE functions that are critical to safety
- Developing and applying realistic human-machine scenarios for use in overall system assessments
- Determining SHFE habitability requirements for space flight

- Developing and validating the design and performance requirements for equipment and procedures, operations, and environments in space and ground support from the human factors viewpoint
- Developing and using ground-based models and analogs for studying space-related SHFE
- Identifying and evaluating SHFE technologies that have applications beyond the space program.

For FY 1998, technical proposals to undertake technology development should concentrate on producing new designs, technologies, and systems needed for space-based and ground-based operations and focus on the following areas.

1. Advanced Displays and Controls Development (AD&CD). The goal of this research area is to improve display and control techniques, both computer-driven simulators (the "glass cockpit") and analogs. Cost issues, fidelity, and when to use new technology should be considered. Specific needs are:
 - Development and evaluation of new methods of presenting information to space and ground crews (such as multimedia and virtual environments) and of inputting commands (such as voice- or touch-activated screens)
 - An approach for developing a hands-free display control that could present suit monitoring parameters, checklists, graphics, etc.
 - Integration of new technology into the space environment
 - Interfaces to information management system.
2. Human-machine Function Allocation The increasing complexity of automation in human-machine systems raises many human factors issues. Specifically, requirements and guidelines for designing interfaces and modes of human-machine interaction, including, for example, the use of fuzzy logic and neural nets, as well as training approaches and procedures to guide the use of such systems.
3. Interaction Among Intelligent Agents Human interactions, with other humans and with intelligent machines, become increasingly important as missions become more diverse and longer in duration. Current knowledge in this area of human factors analysis is very limited. Research is needed to understand the complexity of relationships among intelligent agents and information transfer.
4. Intravehicular (IVA) and Extravehicular Activity (EVA) Input from biomechanical modeling, anthropometric and kinematic methodologies, psychophysics, physical and mental work capacity

measurements, and unit and team task analysis can help to establish guidelines for tool design, workplace layout, human-machine interfaces, work protocol, posture maintenance, body control, and material handling limits for IVA and EVA. Major concerns include: human strength, stamina, range of motion, workload, and physical fatigue. Some specific EVA technology development needs are:

- Technologies, such as virtual reality, integrating dynamics and force feedback into mass handling simulation and to facilitate EVA training (ground-based or in-flight). The in-flight EVA training capability is needed for long-duration missions (e.g., Mars and extended space station missions).
 - EVA Crew member Model – a human-factors-based model of EVA-suited crewmembers is needed to show the interaction between the EVA crew member and Shuttle or Station remote manipulators and payloads. The model should emphasize suited human physical characteristics and performance capabilities and their interactions with the remote manipulators. This includes predicting induced loads, effects of transferring hand-held payloads of varying size and mass, and safety issues.
 - Displays that place the EVA crew member in intuitive contact with the environment including the ability to feel the temperature environment, hear other crew members in a natural space oriented manner, hear the wind on Mars, etc., while wearing a space suit.
 - Human factors studies of walking dynamics aimed at providing data which will aid the design of space suits for partial gravity operation.
5. Analog Studies Earth-based testing and training facilities are critical to the design, development, and maintenance of space human-machine systems. Research in high-fidelity mockups and training simulators and in general environmental analogs is necessary for space missions. Analog studies should enhance human performance in operational procedures for both in-flight and ground-support personnel.
6. Situational Awareness The ability of a space flight crew to acquire and comprehend significant information in the environment while ignoring irrelevant information is especially critical in emergency response activities. Relatedly, the ability to integrate and maintain information about system status, vehicle status, and other crewmembers, is equally important in emergency situations. Assessment of critical crew interfaces (those interfaces the crew encounters during an emergency response procedure) highlights the severe time constraints within which a crew must access relevant information, make crucial decisions, and take coordinated action.

Guidelines and requirements related to situational awareness are needed to enable NASA's development of space vehicles and systems that ensure human crew safety and mission effectiveness.

7. Human Communication Communication among humans and between humans and automated systems is critical for space flight missions. Earth-space communication (audio, video, text, images) will become of increasing complexity based on new technologies available and on the increasing lengths and distances of future space missions. Research activities are needed to enable NASA's development of space vehicles and systems that ensure human crew safety and mission effectiveness. Areas of interest include caution and warning systems, auditory displays, and low-bandwidth digital audio and video.
8. Human Engineering Methodologies Human engineering as a discipline and a process is required for NASA's development of human space flight vehicles and systems. Inadequate application of knowledge about the human body and about human-system integration can result in system designs that are unsafe or ineffective. Processes are needed that maximize the value added by human engineering in the design of space flight systems. Methods are also needed for collecting human performance and preference measurements during the course of long-duration missions and capturing that data using conventional ergonomic measurement and task/equipment development.
9. Space Workstations Concepts for configurable, multi-purpose workstations should be developed. Issues and concerns of using workstations (e.g., gloveboxes) for long-duration tasks should be defined, including electronic procedures and voice commanding.
10. Telescience, Training, and Maintenance Research is needed in human factors issues in delivering just-in-time training, including computer-based and internet-based training for space flight operational and maintenance tasks.
11. Strength Decrements The loss of muscle strength over long-duration space missions is not well quantified and, as such, limits NASA's ability to define realistic strength requirements for space flight tasks. Current requirements are based on Earth-based strength measurements that may be nonconservative for long-duration space flight crews. Operations that may be impacted by strength requirements include nominal tasks, such as crew handling of large masses, as well as critical tasks, such as emergency egress. Issues and concerns should be defined to update NASA strength requirements.

Additional Considerations

Innovation The Space Human Factors Engineering element of the AHST Program especially encourages submission of scientific and technical proposals, based on sound principles, that are innovative in nature, even if this involves some risk of failure.

NASA Mainstreaming Proposers are required to include a projection of the time frame for the anticipated use of their technology in flight systems in all proposals to this NRA. This requirement is not meant to favor near-ready technologies over concept-level, high-risk technologies but rather to stimulate creative and innovative ideas for the incorporation of new technologies into flight systems as early as possible.

In order for applicants to better understand NASA's scientific and technological needs and to be better able to transfer their scientific and technological advances to NASA, it would be of advantage to applicants to explore opportunities for cooperative activity or other interaction associated with their proposal with NASA Space Human Factors personnel through the Johnson Space Center. The appropriate contact person at JSC is:

Mr. Robert Bond
Mail Code SP
NASA Johnson Space Center
Houston, TX 77058
phone: 281-483-3705
fax: 281-244-5773
email: robert.bond@spmail.jsc.nasa.gov

Further information on this Element of the AHST Program can be obtained from the *Space Human Factors Program Plan* (1995) and *Space Human Factors: Critical Research & Technology Definition* (1996) listed in Section VII of this Appendix. These supporting documents can be accessed via the internet at the following World Wide Web address:

<http://www.hq.nasa.gov/office/olmsa/UL/codeul.html>

Flight Proposals Space flight missions represent a unique opportunity for U.S. researchers to analyze habitability and other human factors issues associated with long-duration missions. The lessons learned from this experience can be applied to future human space flight missions. Human factors issues need to be researched and resolved in order to better plan future missions to ensure optimal crew productivity and safety.

Goals for SHFE Flight Proposals:

- Begin characterization of the ISS environment from a habitability standpoint
- Determine lighting conditions and requirements for EVA
- Begin evaluation of crew procedures for logistics resupply inventory management, loose equipment tracking/location, etc.
- Perform mental and physical workload measurements on the crew to assess crew interaction with hardware interfaces and to assess adequacy of crew functional responsibilities.

B. Advanced Life Support

Element Description

The Advanced Life Support Element of the AHST Program was initiated to develop regenerative life support systems directed at NASA's future long-duration missions. Such missions, which can last from months to years, make resupply impractical and necessitate self-sufficiency. Thus, subsystems must be developed to fully recycle air and water, recover resources from solid wastes, grow plants for food, process raw plant products into nutritious and palatable foods, control the thermal environment, and control the overall system.

Advanced life support systems will be a combination of physico-chemical and biological components depending on the specific mission and element of interest. For example, it is anticipated that advanced life support systems used for a planetary transit vehicle will be primarily physico-chemical. More complex systems using biological elements would be used on the planetary surface.

The two main targets for use of advanced life support systems, transit vehicles and planetary surface habitats, illustrate the two major regimes of the microgravity and hypogravity environment which must be accommodated by life support processes. Additionally, advanced life support systems must provide for a safe, habitable environment with high reliability over long periods of time minimizing mass, volume, power, thermal control, and crew time requirements.

Air Revitalization New technologies for air regeneration for long-duration space missions are needed that control particulates, remove carbon dioxide from breathable atmospheres, provide oxygen, and control airborne contaminants all within space craft maximum allowable concentrations (SMACs; see NASA STD-3000). Further, air revitalization systems must accomplish these functions at mass, volume, power, consumables, thermal control requirements, and crew time requirements below those of currently available technologies.

Efforts in system modeling, materials development, subsystem operational performance, and control responsiveness will be required to provide advanced

systems which minimize support expendables and which maximize autonomous operations.

Special emphasis should be placed on technologies which can be made light weight and low volume so that they may also be used in the EVA system portable life support system and as be components of the ISRU production plants. Such across-system use of components and subsystems will be mandatory for Mars missions, which will be extremely weight constrained and unable to support multiple approaches to perform the same function with spares and repair capability.

In this light, proposals are sought in the following areas of research and technology development.

- Prior work has shown that adapting commercial membranes to the removal of carbon dioxide from an EVA system is not presently feasible. Membrane research to tailor a membrane to the task is needed.
- The human body moves carbon dioxide from the body well; research to adapt the mechanisms that provide that function in the body to the task of removing carbon dioxide from the space suit environment are sought.
- The concept of ionizing carbon dioxide with a tuned laser has been demonstrated. Research to see if this phenomena can be adapted to the removal of carbon dioxide from a space suit is sought.
- The Zirconia cell is a carbon dioxide removal mechanism that has potential for cross-system use but requires further research and development.

Water Recovery Technologies are needed for recovery of potable water from wastewater generated by a human crew. Systems must remove organic and inorganic molecules as well as ensure potability of water at the crew use points. Expendables must be minimized along with mass, volume, power, thermal control requirements, and crew time requirements.

Solid Waste Processing Solid waste processing technologies which recover resources from solid wastes (solid human wastes, trash and packaging, and inedible plant biomass) must be developed for space applications. Further, solid waste processing systems must accomplish these functions while minimizing mass, volume, power, thermal control requirements, consumables, and crew time requirements.

Plant Production. In order to close the food loop on long-duration missions, extensive use of plants is necessary to provide nutritious and palatable food for the crews. Some plants will be grown onboard transit vehicles, but it is anticipated that the best application of producing plants for food will be on a planetary surface where the plant growing infrastructure necessary to provide most of the food for space crews can be developed over multiple missions.

Technologies to efficiently grow plants for food (and the concomitant ability of plants to fix carbon dioxide and produce oxygen while transpiring water) are needed for a variety of species necessary to provide a nutritious and palatable source of food for the crews. Technologies must include planting and harvesting including preparation of the raw food material into a form which can be stored or processed directly by the food processing function. Again, plant production systems must accomplish these functions while minimizing mass, volume, power, thermal control requirements, consumables, and crew time requirements.

Food Processing and Storage Plants produced for food require processing into storable food products and into palatable and nutritious dishes for consumption by the crew. Systems examining storage methodologies, processing techniques, and preparation of foods are needed. The same constraints of minimizing mass, volume, power, thermal control requirements, consumables, and crew time requirements apply.

Thermal Control Systems Advanced life support systems consume power and must deal with the space environment; thus they must deal with thermal control. Advanced systems to acquire waste heat, transport it, and then reject it must be developed.

Monitoring and Control The success of life support systems developed for planetary surfaces is critically dependent upon the integration of the biological and non-biological processes and subsystems into a reliable and predictable overall system. To accomplish this, system monitoring, control strategies, and other technologies need to be developed and tested. Research in this area focuses on development of mathematical or laboratory models with particular attention to the application of engineering control theory and, especially for mathematical models, provision for model validation.

Potential applicants should note that research proposed that would, as its primary objective, establish physiological norms for atmospheric gases, identify toxicants, or describe microbial populations (including their densities, pathogenicity, or products) that could be construed as pertinent to the establishment of space flight environmental standards for human health should be submitted to the Environmental Health Element of the Biomedical Research and Countermeasures Program described in Research Opportunities in Space Life Sciences: Gravitational Biology and Biomedical Research and Countermeasures Programs (NRA #96-HEDS-04). Proposals that address the development of sensors to monitor environmental parameters should be submitted to the Advanced Environmental Monitoring and Control Element of the AHST Program described in Section III.C of this Appendix.

Extravehicular Activities (EVA) In addition to the above technologies directed at intravehicular activities, the Program also includes activities that address life support problems associated with advanced extravehicular activities. Specifically,

further technology development is needed in the areas of thermal control systems, atmospheric monitoring and control, and integration of these subsystems. Research is needed in certain areas of portable life support system (PLSS) technology to develop simple, reliable, partially and fully regenerable subsystems that can be packaged into easily maintained micro-climate control systems comparable in size to the fully expendable system currently in use. System size and weight will be even more critical for Lunar and Mars missions during which surface gravity will be on the order of 1/6 g and 1/3 g. Many current PLSS technologies have prohibitive logistical support and maintenance requirements for use on such missions.

Further information on this element can be obtained from the documents: *Advanced Life Support Program Plan (1992)*, *Advanced Life Support Program Requirements (1996)*, and *Controlled Ecological Life Support Systems (CELSS) Program Plan (1992)* listed in Section VI of this Appendix.

Element Emphases for FY 1998

For FY 1998, the primary emphases of the Advanced Life Support (ALS) Element of the AHST Program will be in the areas of:

- System studies
- Development of technologies for solid waste processing
- Water recovery technologies concentrating on urine treatment systems and water polishing (reduction of TOC from 5-10 ppm to less than 0.5 ppm)
- Food processing technologies.

Programmatic relevance for FY 1998 will be evaluated relative to these emphases.

Additional Considerations

Innovation The Advanced Life Support element of the AHST program especially encourages submission of scientific and technical proposals, based on sound principles, that are innovative in nature, even if this involves some risk of failure.

NASA Mainstreaming Proposers are required to include a projection of the time frame for the anticipated use of their technology in flight systems in all proposals to this NRA. This requirement is not meant to favor near-ready technologies over concept-level, high-risk technologies but rather to stimulate creative and innovative ideas for the incorporation of new technologies into flight systems as early as possible.

In order for applicants to better understand NASA's scientific and technological needs and to be better able to transfer their scientific and technological advances to NASA, it would be of advantage to applicants to explore opportunities for

cooperative activity or other interaction associated with their proposal with NASA Advanced Life Support personnel through the Johnson Space Center (JSC). The appropriate contact person at JSC is:

Dr. Donald Henninger
Mail Code EC3
NASA Johnson Space Center
Houston, TX 77058
phone: 281-483-5034
fax: 281-483-5060
email: dhennin1@gp901.jsc.nasa.gov

Further information on this program element can be obtained from the *Advanced Life Support Program Plan (1992)* and the *Advanced Life Support Requirements Document (1996)* listed in Section VII of this Appendix. These supporting documents can be accessed via the internet at the following World Wide Web address:

<http://www.hq.nasa.gov/office/olmsa/UL/codeul.html>

Flight Experiments Knowledge of the effects of microgravity on Life Support Systems is essential for the success of the HEDS Program. A major technology goal of ALS development is to resolve issues of hypogravity performance through research and evaluation in space. Therefore, the program element solicits proposals to examine the gravity sensitivity of candidate life support processes, components, and subsystems.

A significant problem in the development of advanced concepts for life support in microgravity is our insufficient knowledge concerning fluid and fluid/gas interactions in space. Microgravity engineering is a new field in which the fundamental physics is well understood but the engineering principles are still evolving. Consequently, there are no validated models available that can adequately predict the performance of life support hardware designed for microgravity application, especially those handling complex mixed streams of liquids, gases, and solids. As a result, design tools in this area are of limited usefulness. Characterizing the interactions of fluids and gases under conditions relevant to the functioning of life support hardware will be one of the major objectives of the basic flight research program.

Another significant area of concern in the development of bioregenerative life support concepts for future missions is the knowledge that plants are gravity-sensitive but in ways that are not yet understood. Little work has been done on the behavior of higher plants in space, and almost no work has been done on crop plants.

On Earth, researchers have achieved exceptional control over crop productivity and performance, with results that are predictable and repeatable. Basic flight research will focus on achieving a comparable degree of productivity, performance and control in space as on Earth. It should be noted that proposals that address the fundamental mechanisms of the ability of plants to sense and respond to gravity need to be submitted in response to the Gravitational Biology Program as described in the NASA Research Announcement *Research Opportunities in Space Life Sciences: Gravitational Biology and Biomedical Research and Countermeasures Programs* (NRA #96-HEDS-04).

Flight proposals submitted in response to this NRA should emphasize:

Bioregenerative Systems:

- Growth studies of salad-type plants in the microgravity environment
- Evaluation of the microgravity performance of bioregenerative waste water processing technologies

Physical/Chemical Systems:

- Evaluation of the on-orbit performance of advanced oxygen generation technologies focused on increasing the efficiency of this technology to reduce logistics and operations cost requirements for future missions.
- Flight tests of advanced carbon dioxide reduction systems for potential use on future human missions.
- Development of advanced technologies which offer improved liquid/gas separation efficiency with lower power requirements than current Space Shuttle and Space Station designs.
- Evaluation of the performance of advanced urine processing technologies. This effort should focus on developing a urine processing capability that offers significant reductions in the power required to reclaim water from urine when compared with the baseline Space Station VCD system.
- Evaluation of the performance of advanced solid waste processing technologies. Currently, solid waste processing is not performed on the Shuttle or planned for the Space Station. This technology would convert solid wastes, both human and plant, into carbon dioxide, water, salts, and gasses.

C. Advanced Environmental Monitoring And Control

Element Description

The Advanced Environmental Monitoring and Control (AEMC) element of the AHST Program develops advanced technologies which monitor the physical environments of both the human compartments and life support systems of current and future space craft, extravehicular systems and, wherever possible, ensures that these technologies find application in the commercial sector. The AEMC element sponsors technology development activities that:

- Establish new areas of environmental monitoring technology development
- Establish partnerships with industry, universities, and other agencies to facilitate technology development and transfer, both into and out of NASA
- Promote technology transfer of NASA environmental monitoring technology to industry.

Potential applicants should note that all proposals submitted to the Advanced Environmental Monitoring and Control element should include a section that addresses how the proposed technological development may be integrated into current or future NASA technology development projects and a section that discusses potential Earth benefits of the proposed work including, but not limited to, technology transfer to the commercial sector, potential benefits to medical sciences and technology, and potential general benefits to human welfare.

Element Emphases for FY 1998

For FY 1998, the emphasis of the Advanced Environmental Monitoring and Control element will be primarily on environmental sensors for water monitoring and microbial detection. Air monitoring proposals will be accepted but will receive lower priority. This includes the development of new technologies as well as the refinement and microminiaturization of currently available sensors. New proposals in this area will have the highest programmatic priority.

Proposals are also sought in the area of development of technologies technologies designed to improve EVA garments.

The following additional information describes FY 1998 Advanced Environmental Monitoring and Control element technology needs in more detail.

Sensor Technology for Environmental Health The overarching goal for the evolution of a sensing strategy to monitor the health of the space craft environment is to progress from measurements to diagnosis to repair. Long duration space flights with ever-decreasing support from an earth link will

require a concomitant requirement for not only measuring the health of the environment but also a sensing strategy which will allow for self-diagnosis and, ultimately, self-repair.

Toward this goal, sensors are needed in the areas of water, microbial, air and radiation monitoring. What is envisioned is a highly densely distributed system of sensors which are integrated via a local area network and which interface with a trend prediction engine (e.g., a neural net or artificial intelligence) to allow for automated control via feedback and feedforward mechanisms.

The sensor systems should be lightweight, miniature, robust, highly reliable, have a rapid response time, and consume little power. They also should require minimal to zero crew time for repair, maintenance, or sample manipulation; be capable of self-calibration, data processing, and fault diagnosis; and should require minimal volume and zero to minimal consumables, be easily field-serviceable, and be compatible with microgravity.

Specific sensor technology needs:

1. Water Quality Monitors and Sensors NASA is interested in developing monitors that, in addition to meeting the generic requirements described above, are able to identify and quantify target compounds listed in the *AEMC Technology Development Requirements Document*, including physical parameters, inorganic species, and organic compounds (see Bibliography Section of this Appendix); require zero or minimal chemical reagents, compressed gasses, vacuum, or chemical calibration standards; and produce negligible heat and hazardous chemical waste during operation.

Some specific technology advances that are required by NASA include:

- Automated water sample concentrating devices
- Miniaturization of FTIR and liquid chromatography
- Fiber optic sensors for on-line monitoring of chemical constituents
- Volatilization and/or vaporization of liquid samples with subsequent coupling to mass or emission spectrometry

Also of interest is the development or refinement of other new ground-based methods relevant to space flight, which will be used to expand the comprehensive database of chemical contaminants present in space craft wastewater and the processed water produced by terrestrial-based, prototype water processor testing and development.

2. Microbiology Monitors and Sensors Rapid detection, identification, and quantification of microorganisms will be needed to maintain crew health. These microorganisms may be located in air, food, or water or on solid

surfaces. Particular attention must be paid to discerning differences between pathogenic and non-pathogenic and between living and dead organisms.

Guidelines for microorganism species and detection levels are given in the *AEMC Technology Development Requirements Document* (see Bibliography section of this Appendix). Major areas for improvement are in the speed of detection and quantification requiring minimal crew operations and maintenance.

Some specific technology advances that are required by NASA include:

- Rapid and automated cell sorting and identification devices
 - Microbial sensors based on hybridization of DNA and/or RNA probes
 - Integrating and interfacing biological structures and sensors on electronic platforms to produce sensor arrays on chips
 - Rapid and automated techniques based on identification and quantification of marker proteins, lipids and ribosomal RNA
 - Rapid and automated imaging microscopy techniques for species identification and quantification
3. Air Quality Sensors and Monitors Among existing, commercially available technologies for toxic gas monitoring, the current response time of the instruments for sensing various toxic constituents in air is typically on the order of tens of seconds, their masses are on the order of pounds (including signal processing electronics, power supply, and display), and they require sampling and may require vacuum or inert gas purge. Technology development needs to be focused on significantly reducing the mass, volume, power, and other overhead requirements of existing instruments while retaining or improving the ability to quantify specific components in a complex air mixture. Potential improvements in these parameters should be specifically discussed in proposals.

Specific detection needs are listed in *the AEMC Technology Development Requirements Document* (see Bibliography section of this Appendix). These include major species such as oxygen, and a number of trace species. Proposals that target other atmospheric components that may be formed in the space craft environment are also welcomed.

Technologies that can monitor multiple media (e.g., air and water), or that can easily be modified to do so, have the potential to reduce mass and volume in terms of redundant units, i.e., one unit may serve as a backup for two systems. Such multi-use capability will be considered a desirable advantage.

Technologies to Improve Extra Vehicular Activity Garments Astronauts involved in extended EVA activities require garments that provide optimal protection from the harsh environment of space while affording them maximal range of motion and dexterity for work outside the spacecraft. Technologies are solicited to improve astronaut survivability following a puncture of a Thermal Micrometeoroid Garment (TMG) and its underlying bladder material. Also, because Martian materials are believed to be oxidizing (based on prior Martian lander results), research is needed to understand the extent and implications of the possible effects of Martian soils on space suit materials.

Additional Considerations

Innovation The Advanced Environmental Monitoring and Control element of the AHST program especially encourages submission of scientific and technical proposals, based on sound principles, that are innovative in nature, even if this involves some risk of failure.

NASA Mainstreaming Proposers are required to include a projection of the time frame for the anticipated use of their technology in flight systems in all proposals to this NRA. This requirement is not meant to favor near-ready technologies over concept-level, high-risk technologies but rather to stimulate creative and innovative ideas for the incorporation of new technologies into flight systems as early as possible.

In order for applicants to better understand NASA's scientific and technological needs and to be better able to transfer their scientific and technological advances to NASA, it would be of advantage to applicants to explore opportunities for cooperative activity or other interaction associated with their proposal with NASA Advanced Environmental Monitoring and Control personnel through the Jet Propulsion Laboratory. The appropriate contact person is:

Dr. Minoo Dastoor
Mail Stop 180-604
NASA Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109-8099
phone: 818-354-7429

Further information on this element of the AHST Program can be obtained from the *Advanced Environmental Monitoring and Control Technology Requirements Document (1996)* and the *Advanced Environmental Monitoring and Control Strategic Plan (1996)*, listed in Section VII of this Appendix. These supporting documents can be accessed via the internet at the following World Wide Web address:

Flight Experiments This research has as its objective the development of technologies for the monitoring and control of environmental parameters including air/water major constituents and trace contaminants, as well as the microbial environment in air, in water, and on surfaces. Initial activities will focus on the evaluation of advanced environmental sensors and control systems that will help to ensure crew health and safety, while imposing a minimal cost in mass and power consumption.

Sensors which monitor liquids such as water, or which make use of liquids in their operation, face microgravity issues similar to those described in the Advanced Life Support Flight Experiments section above. For example, analysis of head space constituents, a common technique in ground-based laboratories, is problematic in microgravity.

ISS experimental payloads will be accommodated through an ISS rack-based Advanced Sensor Technology Testbed. This testbed will be capable of housing several experimental advanced technology sensors and environments to allow the measurement of air quality, water quality, major constituents, and micro-organisms.

Flight proposals submitted in response to this NRA should emphasize:

- Water quality monitoring sensors. Target parameters and species are listed in the AEMC Technology Development Requirements Document (see Bibliography section of this Appendix). The goal should be the accurate and rapid operation in microgravity by low mass, low power devices and sensors.
- Microbial monitoring sensors. Target species and other requirements are listed in the AEMC Technology Development Requirements Document (see Bibliography section of this Appendix). These sensors may make use of liquid handling methods which require verification in a microgravity environment. Rapid determination of results (two hours or less) is a priority.
- Air quality monitoring sensors. Target parameters and species are listed in the AEMC Technology Development Requirements Document (see Bibliography section of this Appendix).

IV. Flight Experiments

For 1997, proposals for space flight experiments may be submitted in response to this Announcement if they involve any of these three special types of studies:

1. **Short-duration** experiments that can be implemented primarily on the Shuttle without the use of major mission resources; or
2. **Long-duration** experiments that can be implemented with the limited resources available on the International Space Station during the early assembly (construction) phase (1999-2001).
3. **Pre- and post- mission** studies that involve testing the astronaut crew prior to and upon return from their space flight.

All of these experiment types are highly constrained in a number of ways (described below); *proposals requiring resources beyond the capabilities defined below should not be submitted in response to this Announcement.*

Potential applicants should recognize that, given the limited flight opportunities that are available at present, the flight experiments area is likely to be one of the most competitive arenas within the space life sciences for 1997. It is expected that successful flight experiment proposals will represent mature studies strongly anchored in previous or current ground and/or flight research. Ground-based research may, and often must, represent one component of a flight experiment proposal, but that research should be limited to activities that are essential for the final development of an experiment for flight and for the completion and publication of the scientific results of the experiment. In this case, only one (flight) proposal need be submitted. Preparatory ground research designed to define a mature space experiment should be proposed separately and in its own right as part of the ground-based program.

Note that all flight experiments must address one or more of the research programs and emphases defined in Section III above. Applicants proposing flight experiments must fill out the information required on Form C (Appendix C). Flight experiment proposals should emphasize the actual experiment, duration requirements, and experiment conditions. The investigator should allow for flexibility in selecting the best hardware to be used to accomplish the experiment goals. It should be noted that the informed consent of human subjects must be obtained prior to carrying out any study in space, and potential proposers should be aware that obtaining such informed consent will involve a uniform process regardless of country of origin of the proposer.

Applicants should note that flight experiments should be proposed as if the actual flight of the experiment will occur in the period 1999-2001. Experiments that cannot be accomplished within this time period should not be proposed to this Announcement. Preference will be given to those proposals requesting only one flight to accomplish the proposed research; however, with strong justification, applicants may request multiple flight opportunities.

Once selected, flight investigators and NASA must agree on the duration of the period (nominally one year) following receipt of specimens and data during which their investigation will be completed. At the end of this period,

investigators must provide a final report to NASA and should publish the results of their experiments in appropriate peer-reviewed journals. All suitable experimental and reduced data must be submitted to NASA in a form appropriate for archiving in the Space Life Sciences Data Archive, where it will be available to the scientific community.

Finally, potential applicants should be aware that selection for flight is a multi-step process. Following the initial evaluation of flight proposals, a small group of investigators will receive a letter informing them that their experiment has been selected for definition. During the definition phase, NASA will interact with the applicant and determine whether the proposed experiment can actually be carried out on a space mission. At the end of this phase, NASA will select a smaller group of investigations to be developed for flight. **Normally, investigator research funding does not begin until the initiation of the development phase.**

Descriptions of the hardware items available to support human and non-human experiments are included in the International Flight Hardware Catalog (Section 3.0 of *Space Life Sciences Standard Companion Document 1996*). Investigators may propose to use one or more pieces of this flight-certified hardware to implement their experiments or may propose to utilize their own currently existing flight hardware. The development of experiment-unique equipment to implement experiments is discouraged, and individual agencies may not allow such development. However, when exceptional circumstances justify the need for such equipment, such items should be proposed as new developments and the additional costs should be included in the proposal.

A. Short-Duration Flight Experiments

Short duration experiment proposals submitted in response to this Announcement are restricted to experiments that can be accommodated on the Shuttle in addition to the primary mission and that use existing flight hardware. The experiments themselves are usually stand-alone studies that require limited crew training and involvement to execute. It is possible to take advantage of the location in the Shuttle middeck to obtain late pre-flight installation and early post-flight retrieval of materials.

For more information on the shuttle middeck accommodations, please access the web site:

<http://www.ksc.nasa.gov/shuttle/technology/sts-newsref/stsover-prep.html#stsover-mpaccomm>

It is expected that a limited number of flight opportunities will exist for the use of human (crew) subjects and non-human subjects. Note that the number of crew subjects available to support such studies will be limited due to both the late

manifesting of middeck experiments and the limited amount of crew time available to support such experiments.

B. Long-Duration Flight Experiments

Limited research opportunities will be available during the construction phase of the International Space Station. These opportunities shall be longer than the current Shuttle limit of approximately 16 days, but will be constrained in a variety of other ways. Research opportunities will be available during utilization flights when the Shuttle visits the Space Station and during the time period between the utilization flights when the permanent onboard crew will act as experiment operators and, if necessary, as subjects. The duration of microgravity exposure during the 1999-2001 time frame can, in theory, be indefinite with periodic disturbances every 30 days caused by the U.S. and Russian transportation vehicle docking activities. The primary opportunities to transport scientific equipment, supplies, and samples will be on the utilization flights of Shuttle; however, modest capabilities for research-related deliveries and sample returns will be available on assembly flights that take place every 40-90 days.

During the period of time covered by this solicitation, Space Life Sciences research is restricted to the utilization a limited set of hardware. Potential applicants should refer to the International Flight Hardware Catalog section of the *Space Life Sciences Standard Companion Document 1996* for a description of the available hardware. This description represents the early configuration of the Human Research Facility and the European Space Agency's Modular Cultivation System.

It is expected that the following resources will be severely constrained throughout the 1999-2001 time period: crew availability for science operations, power, and logistics resupply (both frequency and mass) to and from the Space Station. Refrigerated stowage on the Shuttle for transport of samples will be very limited, and during certain time frames, refrigerated stowage may not be available on the Space Station. Experiments with few and/or simple in-flight activities have the greatest potential for technical feasibility during this time frame.

C. Pre- and Post-Mission Studies

Opportunities will be available to perform experiments, collect samples, and take physiological measurements utilizing the astronaut crew both prior to their space mission and following their return to Earth. Such proposals are considered flight experiments and should specify the desired activities, the time frame in which these activities must be performed prior to and following the mission, and the required mission duration (e.g., prior to and following a short-duration shuttle mission versus an ISS mission).

V. Proposal Evaluation and Awards Selection Process

The following information is specific to this NRA and **supersedes** the information contained in Sections 13 and 14 of Appendix B, *Instructions for Responding to NASA Research Announcements for Solicited Research Proposals*.

A. Evaluation Factors

The principal elements considered in the independent peer review evaluation of proposals received in response to this NRA will be the **overall scientific or technical value** of the proposed research or technology development and the **cost of the project**. **Relevance to NASA's programmatic needs and goals** will be evaluated in a separate process by NASA. In addition, space flight proposals and proposals to utilize special NASA ground-based facilities will also be evaluated for the **feasibility of implementation** of the proposed project utilizing the requested flight hardware or ground facilities.

For the purposes of this Announcement, scientific proposals are differentiated from technical proposals by two characteristics: the underlying objective of the proposal and the method proposed for reaching that objective. Scientific proposals generally have, as their primary objective, the development of new knowledge through the scientific method (i.e., through the development and testing of a scientific hypothesis). Technical proposals, on the other hand, usually have the development of technologies or processes as their primary objective and propose engineering methods, evaluations, and trade studies to reach their objective. It is the responsibility of each applicant to determine whether his or her submitted proposal is scientific or technical; NASA reserves the right to reclassify submissions prior to review.

Within each of these elements, the following factors are critical to the proposal evaluation and awards selection process:

1. Overall Scientific/Technical Value

The criteria listed below are considered by reviewers when determining overall scientific or technical value.

- Clarity of the project's hypotheses and objectives
- Feasibility of the approach and adequacy of the methods and procedures to carry out the proposed project
- Innovation of the research design
- Originality of the proposed project
- Likelihood that the proposed project will lead to new discoveries or fundamental advances within its field

- Likelihood that the proposed project will lead to new technologies that contribute to NASA's mission or to the health and welfare of the American people
- Familiarity of investigators with the relevant published literature
- Background and documented experience and skills of the investigators and their scientific publication record as an indication of their ability to accomplish and disseminate the proposed research or activity
- For flight investigations, documented maturity of the proposed project (i.e., is project scientifically/technically ready for flight or is further development required?)
- Availability of the investigators to devote adequate time and effort to the project
- Adequacy of institutional resources, facilities, and equipment to support proposed research
- Overall standing among similar proposals available for evaluation and/or evaluation against the known state-of-the-art.

2. Cost

Appropriateness of the budget, including the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds.

3. Relevance to NASA's Programmatic Needs and Goals

Responsiveness to the areas of program element emphasis described in this Announcement.

4. Implementation Feasibility *(Not applicable to all proposals)

Ability to implement the proposed project utilizing the flight and/or ground facilities available.

** For those proposals for which implementation feasibility is necessary to assess, it will be given a weight equal to that of overall scientific/technical value.*

B. Evaluation Techniques

Upon receipt, proposals will be reviewed for compliance with the requirements of this Announcement. All compliant proposals, regardless of type, will undergo merit review by a panel of experts. The number of experts required will be determined by the response to this NRA and by the variety of disciplines represented in the proposals relevant to the research emphasis described in Section III of this Appendix. An engineering and technical review will be conducted by an appropriate engineering evaluation team for those proposals that require determination of the feasibility of implementing the proposed projects

utilizing available flight and/or ground facilities. Following these reviews, NASA program scientist coordinators will prepare a selection plan for each program described in this Announcement. This plan will be based on (1) the ratings and evaluations of the panels of experts according to the above criteria and (2) the contribution of each proposal to the development of a sound scientific/technical research program having the appropriate balance of tasks required by the critical research issues confronting the program as determined by the Human Exploration and Development of Space Strategic Plan. This selection plan will be presented by the program scientist coordinators to the Life Sciences Management Council, a group of senior NASA Headquarters Life Sciences scientists. Following acceptance of the plan by the Council, selection for funding will be made by the Director of the Life Sciences Division.

VII. Program Management Information

A. Type of Awards to be Made

The award instrument will be appropriate to the submitting institution. NASA will fund the institution one year at a time. It is expected that such funding will continue for a total period between one and three years, depending on the proposal requirement, the recommendation of the review panels, and the continuing programmatic contribution of the activity. The number of proposals selected for support will depend on the quality of the proposals received and the availability of funds. However, it is anticipated that approximately 60 awards averaging \$125,000 (total costs) annually will be made, although the total annual cost may vary from \$15,000 to \$350,000. The appropriate program scientist coordinators of NASA's Life Sciences Division will have a primary role in oversight of these awards and will be responsible, with the appropriate NASA field center, for annually evaluating their progress and out-year plans.

B. Eligibility

All categories of institutions and scientists are eligible to submit proposals in response to this NRA. Multi-institutional consortium arrangements also are eligible: the applying entity may collaborate with universities, Federal Government laboratories, the private sector, and state and local government laboratories. In all such arrangements, the applying entity is expected to be responsible for administering the project according to the management approach presented in the proposal.

The applying entity must have in place a documented base of ongoing high quality research in science and technology or in those areas of science and engineering clearly relevant to the specific programmatic objectives and research emphases indicated in this Announcement. Present or prior support by NASA of research

and/or training in any institution or for any investigator is neither a prerequisite to submission of a proposal nor is it a competing factor in the selection process.

C. Foreign Proposals

NASA will accept proposals from all countries in response to this Announcement. Proposals from non-U.S. entities should not include a cost plan. Non-U.S. proposals and U.S. proposals that include non-U.S. participation must be endorsed in writing by the respective government agency or funding/sponsoring institution in that country from which the non-U.S. participant is proposing. Such written endorsement should indicate that

- (1) The proposal merits careful consideration by NASA, and
- (2) If the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.

In addition to sending the original (signed) proposal and twenty (20) copies to NASA through Information Dynamics, Inc., as directed in the next section, **one (1) additional copy along with the Letter of Endorsement must be forwarded to:**

Ms. M. Ruth Rosario
IH/Space Flight Division
Ref: NRA 96-HEDS-04
NASA Headquarters
Washington, DC 20546-0001
USA

All proposals must be typewritten in English. **All non-U.S. proposals will undergo the same evaluation and selection process as those originating in the U.S.** Non-U.S. proposals and U.S. proposals that include non-U.S. participation must follow all other guidelines and requirements described in this NRA. All proposals must be received before the established closing date. Those received after the closing date will be treated in accordance with NASA's provisions for late proposals. Successful and unsuccessful proposers will be contacted directly by the NASA Program Office coordinating this Announcement. Copies of these letters will be sent to the sponsoring government agency.

Should a non-U.S. proposal or a U.S. proposal with non-U.S. participation be selected, NASA's Space Flight Division (Mail Code: IH) will arrange with the non-U.S. sponsoring agency for the proposed participation on a no-exchange-of-funds basis, in which NASA and the non-U.S. sponsoring agency will each bear the cost of discharging its respective responsibilities. Depending on the nature and extent of the proposed cooperation, these arrangements may entail:

- (1) A letter of notification by NASA; and/or
- (2) An exchange of letters between NASA and the sponsoring government agency.

D. Program Reporting

Applicants should note that investigators selected from proposals submitted in response to this Announcement will be expected to provide NASA with annual summary information about their projects. This information will consist primarily of an abstract, bibliographic list, copies of publications, and a statement of progress. This information will be made available to the scientific community and will be used to assess the strength of the Division's programs. Note that although this publication will be made available to the general scientific community, it is not a substitute for traditional scientific reporting in journals and elsewhere.

Investigators selected to carry out space-flight experiments must also provide NASA with two special reports:

- (1) A "quick-look" report of preliminary flight results that is due one month after the space flight takes place, and
- (2) A final report containing all data and information on the flight study due approximately one year after all required data is provided by NASA to the investigator. At this time, all of the data must also be provided to NASA for placement in the Life Sciences Data Archive; data in this archive will be made available to the scientific and technical community.

Additional information may be required of investigators at the time of their annual funding renewal.

E. Deadlines

To facilitate proposal processing, potential principal investigators are requested to confirm plans to submit a proposal responding to this Announcement by sending a **letter of intent to propose**, which is not binding, by 4:30 PM EST, Friday, February 28, 1997. The letter of intent, which should be no more than two pages, should contain:

- The names, addresses, and telephone numbers of a single principal investigator and all co-investigators
- A title descriptive of the research or technical proposal
- A brief summary describing the proposed research, indicating clearly the research program(s) defined in this Announcement that are most relevant to the proposal

- The major participating institutions
- Up to six (6) key words that best describe the research area of the pending proposal. Refer to Appendix C, Required Application Forms and Instructions for Proposal Preparation, for a list of acceptable key words.

Letters of Intent may be submitted through the U.S. Postal Service or commercial delivery services in the same manner as proposals, described below. In addition, letters of intent may be submitted electronically via e-mail to the following address:

loi@hq.nasa.gov

An original signed proposal, plus twenty (20) complete copies of that proposal, and a 3.5-inch computer disk containing an electronic copy of the Principal Investigator's name, address, telephone and fax numbers, e-mail address, and the complete Project Title and Abstract (as provided on Form B) in either Macintosh or IBM (or clone) format must be received by 4:30 PM EDT, Tuesday, April 1, 1997.

Proposals and Letters of Intent mailed through the U.S. Postal Service by express, first class, registered, or certified mail are to be sent to the following address:

Information Dynamics, Inc.
 SUBJECT: NASA Life Sciences Research Proposal
 300 D Street, SW
 Suite 801
 Washington, DC 20024

Proposals and Letters of Intent hand delivered or sent by commercial delivery or courier services are to be delivered to the above address between the hours of 8:00 AM and 4:30 PM. The telephone number (202) 479-2609 may be used when required for reference by delivery services.

Note that Information Dynamics, Inc. (IDI) cannot receive deliveries on Saturdays, Sundays, or federal holidays.

F. Proposal Schedule

The following schedule is planned for the acquisition of investigations under this Announcement:

- | | |
|-----------------------------------|-------------------------------|
| • Letter of Intent to Propose Due | February 28, 1997 |
| • Proposal Due | April 1, 1997 |
| • Selection Announcement | October- November 1997 |
| • Initial Funding Available | October 1997 - September 1998 |

VII. Bibliography

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 - a. **Advanced Life Support Program Plan** (1992).**
 - b. **Advanced Life Support Program Requirements** (1996). **
 - c. **Controlled Ecological Life Support Systems (CELSS) Program Plan** (1992).
 - d. **Space Human Factors Program Plan** (1995). **
 - e. **Space Human Factors: Critical Research & Technology Definition** (1996). **
 - f. **Space Human Factors Discipline Science Plan** (1991).
 - g. **Advanced Environmental Monitoring and Control Strategic Plan** (1996). **
 - h. **Advanced Environmental Monitoring and Control Program: Technology Development Requirements** (1996). **

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<http://www.hq.nasa.gov/office/olmsa/ul/codeul>

3. National Aeronautics and Space Administration, Life Sciences Division, Washington, DC 20546. Cumulative bibliographies of publications resulting from research supported by the Division.*
 - a. **Space Human Factors Publications: 1980-1990.** 1991. K. J. Dickson (Ed.). NASA Contractor Report 4351. (NTIS # N9120620 - \$22.00)
 - b. **Publications of the NASA Controlled Ecological Life Support System (CELSS) Program: 1989-1992.** 1994. J.V. Powers (Ed.). NASA Contractor Report 4603. (NTIS #N9430122 - \$17.50)
4. **A Strategy for Space Biology and Medical Science for the 1980s and 1990s.** National Academy of Sciences. National Research Council. Committee on Space Biology and Medicine. Jay M. Goldberg, Committee

Chairperson. 1987. Washington, DC: National Academy Press. (*NTIS #N8924024 - \$46.50*)

5. **Assessment of Programs in Space Biology and Medicine.** National Academy of Sciences. National Research Council. Committee on Space Biology and Medicine. 1991. Washington, DC: National Academy Press. (*NTIS #N9313327 - \$19.50*)
6. **Exploring the Living Universe: A Strategy for Space Life Sciences.** National Aeronautics and Space Administration Advisory Council. Life Sciences Strategic Planning Study Committee. Frederick C. Robbins, Committee Chairperson. 1988. Washington, DC: National Aeronautics and Space Administration.*
7. **Space Biology and Medicine: Volume II, Life Support and Habitability.** F. M. Sulzman and A. M. Genin (Eds.). 1994. Washington, DC: American Institute of Aeronautics and Astronautics.
8. **Space Physiology and Medicine, 3rd ed.** A. Nicogossian, C. Huntoon, and S. Pool. (Eds.). 1994. Philadelphia, PA: Lea & Febiger.
9. **Strategic Considerations for Support of Humans in Space and Moon/Mars Exploration Missions.** National Aeronautics and Space Administration Advisory Council. Aerospace Medicine Advisory Council. 1992. Washington, DC: National Aeronautics and Space Administration.*

* *Obtaining cited papers:*

Many of the documents may be ordered through your library or through the National Technical Information Service (NTIS). Documents available through NTIS are accompanied by their NTIS order number and price. To order a document through NTIS, call (703) 487-4650. If you are unable to locate a document through this means, please contact Information Dynamics, Inc. at (202) 488-5157.

**Instructions for Responding
to
NASA Research Announcements
for
Solicited Research Proposals**

1. Foreword

- a. NASA depends upon industry, educational institutions and other nonprofit organizations for most of its research efforts. While a number of mechanisms have been developed over the years to inform the research community of those areas in which NASA has special research interests, these instructions apply only to “NASA Research Announcements”, a form of “broad agency announcement” described in 6.102(d)(2) and 35.016 of the Federal Acquisition Regulation (FAR). The “NASA Research Announcement (NRA)” permits competitive selection of research projects in accordance with statute while at the same time preserving the traditional concepts and understandings associated with NASA sponsorship of research.
- b. These instructions are Appendix I to 18-70.203 of the NASA Federal Acquisition Regulation Supplement.

2. Policy

- a. NASA fosters and encourages the submission of research proposals relevant to agency mission requirements by solicitations, "NASA Research Announcements," which describe research areas of interest to NASA. Proposals received in response to an NRA will be used only for evaluation purposes.
- b. NASA does not allow a proposal, the contents of which are not available without restriction from another source, or any unique ideas submitted in response to an NRA to be used as the basis of a solicitation or in negotiation with other organizations, nor is a pre award synopsis published for individual proposals.
- c. A solicited proposal that results in a NASA award becomes part of the record of that transaction and may be available to the public on specific request; however, information or material that NASA and the awardee mutually agree to be of a privileged nature will be held in confidence to the extent permitted by law, including the Freedom of Information Act.

3. Purpose

These instructions are intended to supplement documents identified as "NASA Research Announcements." The NRAs contain programmatic information and certain "NRA-specific" requirements which apply only to proposals prepared in response to that particular announcement. These instructions contain the general proposal preparation information which applies to responses to all NRAs.

4. Relationship to Award

- a. A contract, grant, cooperative agreement, or other agreement may be used to accomplish an effort funded on the basis of a proposal submitted in response to an NRA. NASA does not have separate "grant proposal" and "contract proposal" categories, so all proposals may be prepared in a similar fashion. NASA will determine the appropriate instrument.
- b. Grants are generally used to fund basic research in educational and nonprofit institutions, while research in other private sector organizations is accomplished under contract. Additional information peculiar to the contractual process (certifications, cost and pricing data, facilities information, etc.) will be requested, as necessary, as the procurement progresses. Contracts resulting from NRAs are subject to the Federal Acquisition Regulation and the NASA FAR Supplement (NHB 5100.4). Any resultant grants or cooperative agreements will be awarded and administered in accordance with the NASA Grant and Cooperative Agreement Handbook (NHB 5800. 1).

5. Conformance to Guidance

- a. NASA does not have any mandatory forms or formats for preparation of responses to NRAs; however, it is requested that proposals conform to the procedural and submission guidelines covered in these instructions. In particular, NASA may accept proposals without discussion; hence, proposals should initially be as complete as possible and be submitted on the proposers' most favorable terms.
- b. In order to be considered responsive to the solicitation, a submission must, at a minimum, present a specific project within the areas delineated by the NRA; contain sufficient technical and cost information to permit a meaningful evaluation; be signed by an official authorized to legally bind the submitting organization; not merely offer to perform standard services or to just provide computer facilities or services; and not significantly duplicate a more specific current or pending NASA solicitation. NASA reserves the right to reject any or all proposals received in response to an NRA when such action is considered in the best interest of the Government.

6. NRA-Specific Items

- a. Several proposal submission items will appear in the NRA itself. These include the unique NRA identifier, when to submit proposals, where to send proposals, number of copies required, and sources for more information.
- b. Items included in these instructions may be supplemented by the NRA, as circumstances warrant. Examples are: technical points for special emphasis, additional evaluation factors, and proposal length.

7. Proposal Contents

- a. The following general information is needed in all proposals in order to permit consideration in an objective manner. NRAs will generally specify topics for which additional information or greater detail is desirable. Each proposal copy shall contain all submitted material, including a copy of the transmittal letter if it contains substantive information.

b. Transmittal Letter or Prefatory Material

- (1) The legal name and address of the organization and specific division or campus identification if part of a larger organization
- (2) A brief, scientifically valid project title intelligible to a scientifically literate reader and suitable for use in the public press
- (3) Type of organization e.g., profit, nonprofit, educational, small business, minority, women-owned, etc.
- (4) Name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation
- (5) Identification of any other organizations that are currently evaluating a proposal for the same efforts
- (6) Identification of the specific NRA, by number and title, to which the proposal is responding
- (7) Dollar amount requested of NASA, desired starting date, and duration of project
- (8) Date of submission
- (9) Signature of a responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization (unless the signature appears on the proposal itself).

c. Restriction on Use and Disclosure of Proposal Information

It is NASA policy to use information contained in proposals for evaluation purposes only. While this policy does not require that the proposal bear a restrictive notice, offerors or quoters should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

NOTICE

Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

d. Abstract

Include a concise (200-300 word, if not otherwise specified in the NRA) abstract describing the objective of the proposed effort and the method of approach.

e. Project Description

- (1) The main body of the proposal shall be a detailed statement of the work to be undertaken and should include objectives and expected significance, relation to the present state of knowledge in the field, and relation to previous work done on the project and to related work in progress elsewhere. The statement should outline the general plan of work, including the broad design of experiments to be undertaken and an adequate description of experimental methods and procedures. The project description should be prepared in a manner that addresses the evaluation factors in these instructions and any additional specific factors in the NRA. Any substantial collaboration with individuals not referred to in the budget or use of consultants should be described. Note, however, that subcontracting significant portions of a research project is discouraged.
- (2) When it is expected that the effort will require more than one year for completion, the proposal should cover the complete project to the extent that it can be reasonably anticipated. Principal emphasis should, of course, be on the first year of work, and the description should distinguish clearly between the first year's work and work planned for subsequent years.

f. Management Approach

For large or complex efforts involving interactions among numerous individuals or other organizations, plans for distribution of responsibilities and any necessary arrangements for ensuring a coordinated effort should be described. Aspects of any required intensive working relations with NASA field centers that are not logical inclusions elsewhere in the proposal should be described in this section.

g. Personnel

The principal investigator is responsible for direct supervision of the work and participates in the conduct of the research regardless of whether or not compensation is received under the award. A short biographical sketch of the principal investigator, a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or

other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

h. Facilities and Equipment

- (1) Describe available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any government-owned facilities, industrial plant equipment, or special tooling that are proposed for use on the project.
- (2) Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative to purchase. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for both research and non-research purposes should be explained.

i. Proposed Costs

- (1) Proposals should contain cost and technical parts in one volume: do not use separate "confidential" salary pages. As applicable, include separate cost estimates for salaries and wages; fringe benefits; equipment; expendable materials and supplies, services; domestic and foreign travel; ADP expenses; publication or page charges; miscellaneous identifiable direct costs; and indirect costs. List salaries and wages in appropriate organizational categories (e.g., principal investigator, other scientific and engineering professionals, graduate students, research assistants, and technicians and other non-professional personnel). Estimate all manpower data in terms of man-months or fractions of full-time.
- (2) Explanatory notes should accompany the cost proposal to provide identification and estimated cost of major capital equipment items to be acquired; purpose and estimated number and lengths of trips planned; basis for indirect cost computation (including date of most recent negotiation and cognizant agency); and clarification of other items in the cost proposal that are not self-evident. List estimated expenses as yearly requirements by major work phases. (Standard Form 1411 may be used).
- (3) Allowable costs are governed by FAR Part 31 and the NASA FAR Supplement Part 18-31 (and OMB Circulars A-21 for educational institutions and A-122 for nonprofit organizations).

j. Security

Proposals should not contain security classified material. However, if the proposed research requires access to or may generate security classified

information, the submitter will be required to comply with applicable Government security regulations.

For other current projects being conducted by the principal investigator, provide title of project, sponsoring agency, and ending date.

k. Special Matters

- (1) Include any required statements of environmental impact of the research, human subject or animal care provisions, conflict of interest, or on such other topics as may be required by the nature of the effort and current statutes, executive orders, or other current Government-wide guidelines.
- (2) Proposers should include a brief description of the organization, its facilities, and previous work experience in the field of the proposal. Identify the cognizant Government audit agency, inspection agency, and administrative contracting officer, when applicable.

8. Renewal Proposals

- a. Renewal proposals for existing awards will be considered in the same manner as proposals for new endeavors. It is not necessary that a renewal proposal repeat all of the information that was in the original proposal upon which the current support was based. The renewal proposal should refer to its predecessor, update the parts that are no longer current, and indicate what elements of the proposal are expected to be covered during the period for which extended support is desired. A description of any significant findings since the most recent progress report should be included. The renewal proposal should treat, in reasonable detail, the plans for the next period, contain a cost estimate, and otherwise adhere to these instructions.
- b. NASA reserves the right to renew an effort either through amendment of an existing contract or by a new award.

9. Length

Unless otherwise specified in the NRA, every effort should be made to keep proposals as brief as possible, concentrating on substantive material essential for a complete understanding of the project. Experience shows that few proposals need exceed 15-20 pages. Any necessary detailed information, such as reprints, should be included as attachments rather than in the main body of the proposal. A complete set of attachments is necessary for each copy of the proposal. As proposals are not returned, avoid use of "one-of-a-kind" attachments: their availability may be mentioned in the proposal.

10. Joint Proposals

- a. Some projects involve joint efforts among individuals in different organizations or mutual efforts of more than one organization. Where multiple organizations are involved, the proposal may be submitted by only one of them. In this event, it should clearly describe the role to be played by the other organizations and indicate the legal and managerial arrangements contemplated. In other instances, simultaneous submission of related proposals from each organization might be appropriate, in which case parallel awards would be made.
- b. Where a project of a cooperative nature with NASA is contemplated, the proposal should describe the contributions expected from any participating NASA investigator and agency facilities or equipment which may be required. However, the proposal must be confined only to that which the proposing organization can commit itself. "Joint" proposals which purport to specify the internal arrangements NASA will actually make are not acceptable as a means of establishing an agency commitment.

11. Late Proposals

A proposal or modification thereto received after the date or dates specified in an NRA may still be considered if the selecting official deems it to offer NASA a significant technical advantage or cost reduction.

12. Withdrawal

Proposals may be withdrawn by the proposer at any time. Offerors are requested to notify NASA if the proposal is funded by another organization or of other changed circumstances which dictate termination of evaluation.

13. Evaluation Factors

- a. Unless otherwise specified in the NRA, the principal elements (of approximately equal weight) considered in evaluating a proposal are its relevance to NASA's objectives, intrinsic merit, and cost.
- b. Evaluation of its intrinsic merit includes the consideration of the following factors, none of which is more important than any other:
 - (1) Overall scientific or technical merit of the proposal or unique and innovative methods, approaches, or concepts demonstrated by the proposal.
 - (2) The offeror's capabilities, related experience and publications, facilities, techniques, or unique combinations of these which are integral factors for achieving the proposal objectives.

- (3) The qualifications, capabilities, and experience of the proposed principal investigator, team leader, or key personnel who are critical in achieving the proposal objectives.
 - (4) Overall standing among similar proposals available for evaluation and/or evaluation against the known state-of-the-art.
 - (5) Deliverables and schedules where appropriate.
- c. Evaluation of the cost of a proposed effort includes the consideration of the realism and reasonableness of the proposed cost and the relationship of the proposed cost to available funds.

14. Evaluation Techniques

Selection decisions will be made following peer and/or scientific review of the proposals. Several evaluation techniques are regularly used within NASA. In all cases, however, proposals are subject to scientific review by discipline specialists in the area of the proposal. Some proposals are reviewed entirely in-house where NASA has particular competence; others are evaluated by a combination of in-house people and selected external reviewers, while yet others are subject to the full external peer review technique (with due regard for conflict-of-interest and protection of proposal information), such as by mail or through assembled panels. Regardless of the technique, the final decisions are always made by a designated NASA selecting official. A proposal which is scientifically and programmatically meritorious, but which is not selected for award during its initial review under the NRA may be included in subsequent reviews unless the proposer requests otherwise.

15. Selection for Award

- a. When a proposal is not selected for award, and the proposer has indicated that the proposal is not to be held over for subsequent reviews, the proposer will be notified that the proposal was not selected for award. NASA will notify the proposer and explain generally why the proposal was not selected. Proposers desiring additional information may contact the selecting official who will arrange a debriefing.
- b. When a proposal is selected for award, negotiation and award will be handled by the procurement office in the funding installation. The proposal is used as the basis for negotiation with the submitter. Formal RFPs are not used to obtain additional information on a proposal selected under the NRA process. However, the contracting officer may request certain business data and may forward a model contract and other information which will be of use during the contract negotiation.

16. Cancellation of NRA

NASA reserves the right to make no awards under this NRA and, in the absence of program funding or for any other reason, to cancel this NRA by having a notice published in the Commerce Business Daily. NASA assumes no liability for canceling the NRA or for anyone's failure to receive actual notice of cancellation. Cancellation may be followed by issuance and synopsis of a revised NRA, since amendment of an NRA is normally not permitted.

**Required Application Forms
and
Instructions for Proposal Preparation**

This section contains the general instructions for proposal preparation and the specific forms required by proposers responding to agency solicitations in the space life sciences for 1997. The forms at the end of this section include the following:

Agency-Independent Forms

- Form A Solicited Proposal Application
- Form B Proposal Summary
- Form C Space-Flight Experiment Supplementary Application Information
(Optional)
- Form D Checklist for Proposers
- Form E Multinational Space Station Human Research Informed Consent

Agency-Specific Forms

National Aeronautics and Space Administration (NASA)

- Form US-1 Program Applicability
- Form US-2 Detailed Budget, First Year
- Form US-3 Detailed Budget, Entire Project Period
- Form US-4 Certification Regarding Drug-free Workplace Requirements
- Form US-5 Certification Regarding Debarment, Suspension, and Other
Responsibility Matters
- Form US-6 Certification Regarding Lobbying

Instructions for Proposal Preparation

The information contained in these instructions is specific to this Announcement and supplements the general guidance provided in Appendix B.

All U.S. proposals should include one copy of each of the forms provided in this Appendix as part of the complete submission, with the exception of Form C that is submitted only with flight experiments. Non-U.S. proposals with no U.S. component are not required to submit Forms US-1, US-2, US-3, US-4, US-5, or US-6.

The proposal should include the following material, in this order:

- (1) Transmittal Letter
- (2) Cover Page: Solicited Proposal Application (Form A)*
- (3) Proposal Abstract (Form B)
- (4) Detailed Budget, 12 Month (Form US-2)
- (5) Detailed Budget, Entire Project Period (Form US-3)
- (6) Proposal Title Page, with Notice on Restriction on Use and Disclosure of Proposal Information, if any
- (7) Project Description
- (8) Space Flight Experiment Supplementary Application Information (to be submitted with flight experiments only) (Form C)
- (9) Management Approach
- (10) Personnel
- (11) Facilities and Equipment
- (12) Supporting Budgetary Information
- (13) Special Matters (specific information on animal and/or human subjects protocol approval required, if applicable)*
- (14) Certification Regarding Drug-Free Workplace (Form US-4)*
- (15) Certification Regarding Debarment, Suspension, and Other Responsibility Matters (Form US-5)*
- (16) Certification Regarding Lobbying (Form US-6)*
- (17) Computer diskette (3.5 inch, Macintosh or PC format) containing an electronic copy of the principal investigator's name, address, telephone and Fax numbers, e-mail address, and the complete project title and abstract as provided on Form B
- (18) Checklist for Proposers (Form D)
- (19) Appendices, if any

* One signed original required

Except for the Project Description Section, there is no specific page limitation on proposals submitted. However, every effort should be made to keep proposals as brief as possible. The name of the Principal Investigator should appear in the upper right hand corner of each page of the proposal, except on the Forms in this

Appendix where special places are provided for this information. Note that the proposal must specify the period of performance for the work described; periods of performance may be for any duration up to four (4) years but should be suitable for the project proposed.

(1) Transmittal Letter

The transmittal letter should contain, at least:

- (a) The legal name and address of the organization and specific division (or campus identification if part of a larger organization) that proposes to carry out the project
- (b) A brief project title intelligible to a scientifically literate reader and suitable for use in the public press
- (c) The name and telephone number of the principal investigator and business personnel who may be contacted during evaluation or negotiation
- (d) The identification of the specific NRA, by number and title, to which the proposal is responding
- (e) The signature of the responsible official or authorized representative of the organization, or any other person authorized to legally bind the organization

A copy of the Checklist for Proposers (Form D) should be attached to this letter. Only one copy of the transmittal letter is required; it should be attached to the single original signature version of the submitted proposal.

(2) Cover Page: Solicited Proposal Application (Form A)

The information on Form A must be filled out completely, and one original signature version of this form should be submitted with the transmittal letter above.

For Item (7) on this form, new means that a proposal for this project has not been submitted to NASA in 1995 or 1996, renewal means that this proposal is for the continuation of an already funded task beyond the term of the funded proposal, and revised means that this proposal represents a revision of a proposal submitted to NASA in 1995 or 1996, but not funded. A proposal previously submitted but not funded should be termed revised even if the original principal investigator has changed for 1997. Renewal and revised applications should contain special material described in the Project Description section, below.

Note that items (9) and (10) on Form A require assurance of compliance with human subject and/or animal care provisions of NASA regulations (see Special

Matters section, below). Applicants should be aware that review of a proposal will not be undertaken without prior assurance of compliance.

(3) Proposal Abstract (Form B)

The information requested on this form is essential to the review of the proposal. It determines how the application will be evaluated and which program manager(s) will receive the final review materials for possible inclusion in one of the research programs of the Division. Applicants are requested to classify their proposals as either scientific or technical. Scientific proposals should be differentiated from technical proposals by two characteristics – the underlying objective of the proposal and the method proposed for reaching that objective. Scientific proposals generally have, as their primary objective, the development of new knowledge through the scientific method (i.e., through the development and testing of a scientific hypothesis). Technical proposals, on the other hand, usually have the development of technologies or processes as their primary objective, and propose engineering methods, evaluations, and trade studies to reach their objective.

(4) Detailed Budget, 12 Month (Form US-2)

(5) Detailed Budget, Entire Project Period (Form US-3)

These forms are self-explanatory budget forms that must be submitted with each U.S. proposal, or with non-U.S. proposals that have a U.S. component for which NASA funding is sought.

Foreign proposals with no U.S. component should not submit these forms but, as explained in Appendix A, should be endorsed in writing by the respective government agency or funding/sponsoring institution in that country from which the non-U.S. participant is proposing. This endorsement should indicate that:

- (a) The proposal merits careful consideration by NASA, and
- (b) If the proposal is selected, sufficient funds will be made available to undertake the activity as proposed.

(6) Proposal Title Page, with Notice on Restriction on Use And Disclosure of Proposal Information, If Any

The title page should contain the project title, name and address of the submitting institution, the name, address and telephone number of the Principal Investigator, and the names and institutions of any co-investigators. It is NASA policy to use information contained in proposals for evaluation purposes only. While this policy does not require that the proposal bear a restrictive notice, offerors or quoters

should, in order to maximize protection of trade secrets or other information that is commercial or financial and confidential or privileged, place the following notice on the title page of the proposal and specify the information subject to the notice by inserting appropriate identification, such as page numbers, in the notice. In any event, information (data) contained in proposals will be protected to the extent permitted by law, but NASA assumes no liability for use and disclosure of information not made subject to the notice.

NOTICE

Restriction on Use and Disclosure of Proposal Information

The information (data) contained in [insert page numbers or other identification] of this proposal constitutes a trade secret and/or information that is commercial or financial and confidential or privileged. It is furnished to the Government in confidence with the understanding that it will not, without permission of the offeror, be used or disclosed other than for evaluation purposes; provided, however, that in the event a contract (or other agreement) is awarded on the basis of this proposal the Government shall have the right to use and disclose this information (data) to the extent provided in the contract (or other agreement). This restriction does not limit the Government's right to use or disclose this information (data) if obtained from another source without restriction.

(7) Project Description

The length of the Project Description section of the proposal should not exceed 25 pages using regular (12 point) type. The proposal should contain sufficient detail to enable a reviewer to make informed judgments about the overall merit of the proposed research and about the probability that the investigators will be able to accomplish their stated objectives with the resources requested and with their own resources. In addition, the proposal should indicate clearly the relationship between the proposed work and the research emphases defined in this Announcement. The project description should be consistent with the type of proposal that is being submitted (ground-based research investigation or space flight experiment). If an investigator wishes to propose related studies of two different types (e.g., a ground-based research investigation and a related space-flight experiment), then two proposals should be submitted with their linkage described in each proposal.

Renewal applications (for competing renewal of currently funded activity) must include a progress report as an Appendix to the proposal, and should refer to this Appendix appropriately throughout the Project Description section.

Revised applications (revisions of 1995 or 1996 submissions) must include, as part of the Project Description section, an **Introduction** that contains responses to the criticisms in the previous critique. Applicants should highlight the changes they have made in their research plan by appropriate bracketing, indenting, or changing of typography. Clearly present any work done since the prior version was submitted. Note that revised applications that do not address the criticisms in the previous critique and/or include substantial revisions may be penalized in the review process.

(8) Space Flight Experiment Supplementary Application Information (Optional, Form C)

All applicants proposing space flight research should complete Form C. The information on this form is essential for the evaluation of the feasibility of carrying out the proposed study. Before filling out this form, applicants should read Section 2.0 of the *Space Life Sciences Standard Companion Document 1996* carefully and make certain that they understand the accommodation constraints that are associated with flight experiments. In addition, applicants should utilize available equipment to implement the proposed experiment (as listed in Section 3.0 of the companion document), or should provide a low-cost available alternative. Failure to do this may preclude implementation of the experiment.

(9) Management Approach

Each proposal must specify a single principal investigator who is responsible for carrying out the proposed project and coordinating the work of other personnel involved in the project. In proposals that designate several senior professionals as key participants in the research project, the management approach section should define the roles and responsibilities of each participant, and note the proportion of each individual's time to be devoted to the proposed research activity. The proposal should state clearly and unambiguously whether these key personnel have reviewed the proposal and endorsed their participation.

(10) Personnel

The principal investigator is responsible for direct supervision of the work and participates in the conduct of the research regardless of whether or not compensation is received under the award. A short biographical sketch of the principal investigator that includes his or her current position title and educational background, and a list of principal publications and any exceptional qualifications should be included. Omit social security number and other personal items which do not merit consideration in evaluation of the proposal. Give similar biographical information on other senior professional personnel

who will be directly associated with the project. Give the names and titles of any other scientists and technical personnel associated substantially with the project in an advisory capacity. Universities should list the approximate number of students or other assistants, together with information as to their level of academic attainment. Any special industry-university cooperative arrangements should be described.

(11) Facilities and Equipment

Describe the available facilities and major items of equipment especially adapted or suited to the proposed project, and any additional major equipment that will be required. Identify any government-owned facilities, industrial plant equipment, or special tooling that are proposed for use on the project. Provide evidence that such facilities or equipment will be made available if the applicant is successful in obtaining funding. Before requesting a major item of capital equipment, the proposer should determine if sharing or loan of equipment already within the organization is a feasible alternative to purchase. Where such arrangements cannot be made, the proposal should so state. The need for items that typically can be used for both research and non-research purposes should be explained.

(12) Supporting Budgetary Information

This section should include the supporting information required by Forms US-2 and US-3. In this NRA, the terms "cost" and "budget" are used synonymously. Sufficient proposal cost detail and supporting information will facilitate a speedy evaluation and award. Dollar amounts proposed with no explanation (e.g., Equipment: \$1,000, or Labor: \$6,000) may cause delays in evaluation and award. Generally, NASA will evaluate costs as to reasonableness, allowability, and allocatability. The budgetary forms define the desired detail, but each category should be explained in the body of the proposal. Offerors should exercise prudent judgment in determining what to include in the proposal, as the amount of detail necessarily varies with the complexity of the proposal.

The following examples indicate the suggested manner to prepare a cost breakdown.

Direct Labor

Labor costs should be segregated by titles or disciplines with estimated hours and rates for each. Estimates should include a basis of estimate such as currently paid rates or outstanding offers to prospective employees. This format allows the Government to assess cost reasonableness by various means including comparison to similar skills at other organizations. Example:

<u>Hours</u>	<u>Rate</u>	<u>Amount</u>	
Principal Investigator	100	\$19.34	\$1,934
Co-Investigator	450	\$11.78	\$5,301
Clerical Support	<u>75</u>	<u>\$ 8.70</u>	<u>\$ 652</u>
Total	625		\$7,887

Indirect Costs

Indirect costs should be explained to an extent that will allow the Government to understand the basis for the estimate. Examples of prior year historical rates, current variances from those rates, or an explanation of other basis of estimates should be included. Where costs are based on allocation percentages or dollar rates, an explanation of rate and application base relationships should be given. For example, the base to which the General and Administrative (G&A) rate is applied could be explained as: application base equals total costs before G&A less subcontracts.

Other Costs

Each significant cost category, such as travel, should be detailed, explained, and substantiated. Past experience has indicated that up to six trips may be necessary for a flight experiment. (i.e., Crew Familiarization (Johnson Space Center, JSC), pre-flight Science Verification Test (Kennedy Space Center, KSC), L-14 day Press Briefing (JSC), Mission Preparation/Operations (KSC), Post-Flight Ground Control (KSC), Post-Flight Results Symposium). Format should be as follows:

Travel Costs

<u>Destination</u>	<u>Duration</u>	<u>Airfare</u>	<u>Per Diem</u>	<u>Total</u>
Moffett Field, CA	3 days	\$500	\$300	\$800
Washington, DC.	1 day	\$500	\$100	<u>\$600</u>
Total				\$1,400

If the proposal is for competitive renewal of an ongoing research effort beyond the present period of approval, the proposal cost section should include an estimate of any significant amount of unspent or uncommitted funds remaining at the completion of the current period of performance.

The supporting budgetary information section of the proposal should include information concerning other current projects being conducted by the Principal Investigator and funded either by NASA or any other Government agency.

Provide the title of project, the sponsoring agency, the project period, the investigator's time commitment, and the value of the project. The following format is recommended:

Funding Organization	Title	Number	Total Project		Direct Costs
			Period	Total Effort	
NIH	Bone	R01 NS	12/89-11/94	30%	\$100,000
	Mineralization	01234-06			
NSF	Osteosclerosis	DRF 7683-05	6/90-5/93	10%	\$20,000

(13) Special Matters

The Special Matters section must contain a statement from the proposer's institution which states that the proposed work will meet all Federal and local human subject requirements and animal care and use requirements, if applicable. Note that no animal subjects may be utilized unless specific information justifying and describing their use is included in the proposal. Policies regarding the protection of human research subjects in NASA-sponsored research are detailed in NASA Management Instruction (NMI) 7100.8B (Protection of Human Research Subjects), and animal care and use requirements are detailed in the NASA Code of Federal Regulations (CFR) 1232 (Care and Use of Animals in the Conduct of NASA Activities), both of which are available from the Life Sciences Division, Code UL, NASA Headquarters, Washington, DC 20546. Assurance of compliance with human subject and/or animal care provisions is required on Form A, to be submitted with each proposal. In addition, a letter signed by the chairperson of the Institutional Review Board (IRB) or institutional Animal Care and Use Committee (ACUC) or both, as appropriate, regarding approval of the experimental protocol, should be included with each copy of the proposal. All non-NASA proposals providing ACUC approval must also contain the institution's Public Health Assurance number. All non-US proposals should provide certification from the investigator's institution stating that the proposal has been reviewed and approved to be compliant with international regulations on bioethics standards for the use of animals or humans in research. Applicants should note that this is a strong requirement: **Review of the proposal will not be undertaken until this information is supplied to NASA.**

NASA is a participating agency for the "Presidential Early Career Awards for Scientists and Engineers." NASA will select its Awardees based on exceptionally meritorious proposals funded through the traditional grants process, including this NRA. Awardees must be U.S. citizens, nationals, or permanent residents who have received their highest degree within five years.

- (14) Certification Regarding Drug-Free Workplace (Form US-4)**
- (15) Certification Regarding Debarment, Suspension, and Other Responsibility Matters (Form US-5)**
- (16) Certification Regarding Lobbying (Form US-6)**

These three certifications are required of all U.S. applicants before a grant/contract can be awarded. They are not required of foreign proposals with no budget section.

- (17) Computer Diskette (3.5 Inch, Macintosh Or PC format) containing an electronic copy of the Principal Investigator's name, address, telephone and fax numbers, e-mail address, and the complete Project Title and Abstract as provided on Form B**

Self-explanatory.

- (18) Checklist for Proposers (Form D)**

One copy of a completed version of this checklist should be attached to the transmittal letter.

- (19) Appendices, If Any**

Renewal applications (for competing renewal of currently funded activity) must include an Appendix providing a Progress Report of the previously funded activity. That report should give the beginning and ending dates for the period covered since the project was last reviewed competitively and provide a list of all personnel who have worked on the project during this period (including dates of service and percentages of their appointments devoted to the project). The report should also summarize the previous project's original goals and specific objectives and provide a succinct account of published and unpublished results indicating progress toward their achievement. Changes in these objectives during the course of the project and a rationale for these changes should be presented. The importance of the findings should be summarized and discussed. Finally, a list should be provided of the titles and complete references to all publications, manuscripts submitted or accepted for publication, patents, invention reports, and other printed materials that have resulted from the project since it was last competitively reviewed.

Other Appendices may be appropriate for particular proposals.

FORM A**SOLICITED PROPOSAL APPLICATION FOR SPACE LIFE SCIENCES**

IN RESPONSE TO ANNOUNCEMENT # _____

PLEASE FOLLOW INSTRUCTIONS CAREFULLY

LEAVE BLANK

NUMBER

REVIEW GROUP

DATE RECEIVED

1. COMPLETE TITLE OF PROJECT

2. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR *(First, middle, and last name; degrees; position title)*

3. COMPLETE MAILING ADDRESS

4. TELEPHONE NUMBER
(area code, number, extension)

FAX NUMBER

E-MAIL ADDRESS

5. CONGRESSIONAL DISTRICT (U.S. ONLY)

6. SOCIAL SECURITY # (U.S. ONLY)

7. IS THIS PROPOSAL ☐ NEW ☐ RENEWAL ☐ REVISED

8. HAS THIS PROPOSAL (OR SIMILAR REQUEST) BEEN SUBMITTED TO ANY OTHER AGENCY?

☐ No☐ Yes

IF YES, SPECIFY AGENCY AND YEAR SUBMITTED:

9. CO-INVESTIGATORS *(First, middle, and last name; degrees)*

10. CO-INVESTIGATOR'S ORGANIZATION

11. DATES OF ENTIRE PROPOSED
PROJECT PERIODFrom:
Through:12. COSTS REQUESTED FOR FIRST
12-MONTH BUDGET PERIOD12a. Direct Costs
\$12b. Total Costs
\$13. ~~PROPOSED BUDGET PERIOD~~13a. Direct Costs
\$13b. Total Costs
\$14. APPLICANT ORGANIZATION *(Organization Name)*

15. TYPE OF ORGANIZATION (U.S. ONLY)

☐ Non Profit☐ For Profit *(General)*☐ For Profit *(Small Business)*☐ Public, Specify:☐ Federal☐ State☐ Local16. ~~PROVIDE NAME, TITLE, ADDRESS AND TELEPHONE NUMBER~~
ORGANIZATION OFFICIAL TO BE NOTIFIED IF AN AWARD17. ~~OFFICIAL SIGNING FOR APPLICANT ORGANIZATION~~
(Name, Title, Last Name, First Name, Middle Initial)

18. PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR ASSURANCE:

SIGNATURE OF PERSON NAMED IN 2
(In ink "Per" signature not acceptable.)

DATE

19. CERTIFICATION AND ACCEPTANCE:

SIGNATURE OF PERSON NAMED IN 17
(In ink "Per" signature not acceptable.)

DATE

FORM B

PROPOSAL ABSTRACT

Principal Investigator: _____

Proposal Title: _____

Abstract

{Prepare a brief description of the application stating the broad, long-term objectives and specific aims of the proposed work. Describe concisely the research design and methods for achieving these objectives and aims. This abstract is meant to serve as a succinct and accurate description of the proposed work when separated from this application. Limit abstract to 300 words or fewer.}

Key Words:

{Assign numbers (1- highest relevance, 3-moderate relevance) to the areas that best describe your proposed research. Choose a maximum of three areas}

- | | | |
|---------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------|
| <input type="checkbox"/> Neuroscience | <input type="checkbox"/> Spacecraft Systems and Hardware | <input type="checkbox"/> Developmental Biology |
| <input type="checkbox"/> Regulatory Physiology | <input type="checkbox"/> Space Suit Design | <input type="checkbox"/> Genetics |
| <input type="checkbox"/> Behavior | <input type="checkbox"/> EVA/IVA Physiology | <input type="checkbox"/> Plant Biology |
| <input type="checkbox"/> Human Factors Studies | <input type="checkbox"/> Radiation Biology | <input type="checkbox"/> Molecular Biology |
| <input type="checkbox"/> Skeletal System | <input type="checkbox"/> Cell Biology | <input type="checkbox"/> Reproductive Physiology |
| <input type="checkbox"/> Muscle Physiology | <input type="checkbox"/> Radiation Physics | <input type="checkbox"/> Immunology |
| <input type="checkbox"/> Air/Food/Water
Regeneration | <input type="checkbox"/> Cardiopulmonary Physiology | <input type="checkbox"/> Other _____ |

FORM C
SPACE FLIGHT EXPERIMENT SUPPLEMENTARY APPLICATION FORM

The following form should be completed by all investigators proposing flight experiments. This form should be inserted into the Project Description section of the proposal. (Provide responses on additional sheets, as necessary.)

Principal Investigator _____

Proposal Title _____

Type of Flight Experiment: ____ **Short Duration** ____ **Long Duration** ____ **Pre/Post-Flight**

- (1) If humans are required as subjects for the proposed investigation, please list
 - a) number of subjects
 - b) special subject restrictions, such as specific dietary regimens or fluid intake regulation
 - c) special experiment protocols, such as specific work/rest cycles or exercise
 - d) physiological variables to be measured.
- (2) If non-humans are required for the proposed investigation, please list
 - a) scientific name of species and common name
 - b) gender, strain, age, stage, and weight (if applicable)
 - c) minimum number required, desired number, and a rationale for both
 - d) special requirements for maintenance or manipulation of the specimens.
- (3) List major hardware items required in this investigation. Hardware items are listed in the document titled "*Standard Companion Document for Space Life Sciences, 1996*".
- (4) Estimate access time
 - a) Is late access needed and when (i.e., do you need to load the experiment and/or species within a certain time period before a launch)?
 - b) Is early removal needed and when (i.e., do you need to remove the experiment and/or species within a certain time period after landing? If so, please specify requirement.)?
- (5) Identify potentially hazardous materials, including biowaste.
- (6) Are there any specific conditions requested, such as air composition, humidity, temperature control, or illumination?
- (7) For Space Station experiments, estimate the maximum and minimum number of days of microgravity exposure required.
- (8) Estimate the total set of operations required to carry out the experiment in space (e.g., the number of sessions of crew activity and the time required for each session).
- (9) Estimate amount of time for crew participation with experiment before, during and after flight (e.g., data collection, crew training, etc.)

Responses (continue on additional sheets):

FORM D

CHECKLIST FOR PROPOSERS

The following Checklist should be enclosed with the transmittal letter and annotated to indicate that the stated items have been included in the proposal package.

Principal Investigator/Program Director _____

_____ Form A: Solicited Proposal Application*	_____ Facilities and Equipment
_____ Form B: Proposal Summary	_____ Supporting Budgetary Information (include current support: list of other funded projects)
_____ Form US-2: Detailed 12 month Budget (First year of support)	_____ IRB or ACUC letter/ form regarding protocol approval, if applicable*
_____ Form US-3: Summary Budget Form	_____ Form US-4: Certification Regarding Drug-Free Workplace*
_____ Title Page	_____ Form US-5: Certification Regarding Debarment, Suspension, and Other Responsibility Matters*
_____ Project Description	_____ Form US-6: Certification Regarding Lobbying*
_____ Form C: Space-Flight Exp. Supplementary Information, if applicable	_____ Appendices, if any
_____ Management Approach	_____ 20 copies of all material listed above
_____ Personnel, CVs; Biographical Summaries	_____ 3.5 inch computer diskette

*One signed original form required.

Only one copy of the following materials needs to be submitted:

_____ Transmittal Letter
_____ Form D: This checklist indicates all items have been enclosed

FORM E
MULTINATIONAL SPACE STATION
HUMAN RESEARCH INFORMED CONSENT*

1. I, the undersigned, do voluntarily give my informed consent for my participation as a test subject in the following research study, test, or investigation:

NAME OF INVESTIGATION _____

MISSION TO WHICH ASSIGNED _____

PRINCIPAL INVESTIGATOR _____

RESPONSIBLE PROJECT SCIENTIST _____

I understand or acknowledge that:

- (a) This procedure is part of an investigation approved by participating agencies.
- (b) I am performing these duties as part of my employment with _____.
- (c) This research study has been reviewed and approved by the Multinational Review Board (MRB) which has also determined that the investigation involves _____ risk to the subject.
(minimal or reasonable)
- (d) Definitions:
“Minimal risk” means that the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests.

“Reasonable risk” means that the probability and magnitude of harm or discomfort anticipated in the research are greater in and of themselves than those ordinarily encountered in daily life or during the performance of routine physical or psychological examinations or tests, but that the risks of harm or discomfort are considered to be acceptable when weighed against the anticipated benefits and the importance of the knowledge to be gained from the research.
- (e) The research procedures were explained to me prior to the execution of this form. I was afforded an opportunity to ask questions, and all questions asked were answered to my satisfaction. A layman’s description was provided to me.**
- (f) I consider myself physically and mentally qualified to participate in the investigation.
- (g) I know that I can refuse to participate in the tests at any stage of their performance, and my refusal will be honored, except in those cases when, in the opinion of the responsible physician, termination of the tests could have detrimental consequences for my health and/or the health of the other subjects. However, understanding the significance of the investigations (tests), I will give every effort to perform the full scope of the program.
- (h) In the event of injury resulting from this study, I understand that I will receive medical attention and necessary treatment. I also understand that I will be compensated for any injuries to the extent permitted under current _(TBD)_ and the provisions of the contract between _(TBD)_. My agreement to participate shall not be construed as a release of _(TBD)_ or any third party from any future liability which may arise from, or in connection with, the above procedures.

- (i) Consistent with statutory and Agency-approved routine uses under the _(TBD)_, the confidentiality of any data obtained as a result of my participation as a research subject in this study shall be maintained, so that no data may be linked with me as an individual. However, if a “life-threatening” abnormality is detected, the investigator will notify me and the _(TBD)_. Such information may be used to determine the need for care or medical follow-up, which, in certain circumstances, could affect my professional (flight) status.

Test Subject

Date

2. I, the undersigned, the Principal Investigator of the investigation designated above, certify that:

- (a) I have accurately described the procedure and related risk(s) to the test subject.
- (b) The test setup involves _____ risk to the test subject as determined by the MRB.
(minimal or reasonable)
- (c) All equipment to be used has been inspected and certified for safe and proper operation.
- (d) The test subject is qualified to participate in my experiment protocol.
- (e) The test protocol has not been changed from that originally approved by the MRB.

Principal Investigator

Date

Concurrence:

Project Scientist

Date

Notes:

* This form is valid for the period including preflight, in-flight, and postflight data collection sessions for the mission. Before the first baseline data collection, the Principal Investigator will repeat the briefing concerning risks involved in the investigation. A signed, dated copy of this form with attachments must be forwarded to Chair, Multinational Review Board.

** A detailed description of the investigation will be attached to this consent form. The Principal Investigator is responsible for formulating this document, which should be in layman’s terms such that the subject clearly understands what procedures will be required and the risks associated therewith. The detailed description of the research procedures must specifically list the risks associated with the procedures to be employed, the possible adverse reactions of all medications to be administered, and the risks/hazards resulting from exposure to ionizing radiation. Further, the investigator must clearly specify all forms of subject behavior interdicted by the research protocol (exercise, diet, medications, etc.).

FORM US-1**PROGRAM APPLICABILITY****Principal Investigator:** _____**Co- Investigators:** _____

_____**Proposal Title:** _____
_____**Proposal Type:****SCIENTIFIC PROPOSAL** _____
OR
TECHNICAL PROPOSAL _____**GROUND-BASED RESEARCH** _____
OR
SPACE FLIGHT EXPERIMENT _____

{Place a single check in the "Primary Area" column next to the program that is most closely aligned with your proposal. Optional: Place a check in the "Secondary Area" column **if** your proposal has a dual-program emphasis}

	<u>Primary Area</u>	<u>Secondary Area</u>
GRAVITATIONAL BIOLOGY	_____	_____
SPACE PHYSIOLOGY	_____	_____
ENVIRONMENTAL HEALTH	_____	_____
SPACE RADIATION HEALTH	_____	_____
BEHAVIOR & PERFORMANCE	_____	_____
ADVANCED TECHNOLOGY DEVELOPMENT	_____	_____
SPACE HUMAN FACTORS ENGINEERING	_____	_____
ADVANCED LIFE SUPPORT	_____	_____
ADVANCED ENV. MONITORING & CONTROL	_____	_____

FORM US-2

PRINCIPAL INVESTIGATOR/PROGRAM DIRECTOR: _____

DETAILED BUDGET FOR 12-MONTH BUDGET PERIOD DIRECT COSTS ONLY			FROM	THROUGH	
Duplicate this form for each year of grant support requested			DOLLAR AMOUNT REQUESTS <i>(Omit cents)</i>		
PERSONNEL <i>(Applicant Organization Only)</i>		EFFORT ON PROJECT	SALARY	FRINGE BENEFITS	TOTALS
NAME	ROLE IN PROJECT				
	Principal Investigator				
SUBTOTALS →					
CONSULTANT COSTS					
EQUIPMENT <i>(Itemize, use additional sheet if needed)</i>					
SUPPLIES <i>(Itemize by category, use additional sheet if needed)</i>					
TRAVEL	DOMESTIC				
	NON-DOMESTIC				
OTHER EXPENSES <i>(Itemize by category, use additional sheet if needed)</i>					
TOTAL DIRECT COSTS FOR FIRST 12-MONTH BUDGET PERIOD <i>(Item 12a, Form A)</i>				\$	
INDIRECT COSTS FOR FIRST 12-MONTH BUDGET PERIOD				\$	
TOTAL COSTS FOR FIRST 12-MONTH BUDGET PERIOD <i>(Item 12b, Form A)</i>				\$	

BUDGET FOR ENTIRE PROJECT PERIOD DIRECT COSTS ONLY

BUDGET CATEGORY TOTALS		1st BUDGET PERIOD	ADDITIONAL YEARS OF SUPPORT REQUESTED		
			2nd	3rd	4th
PERSONNEL (Salary and Fringe Benefits) (Applicant organization only)					
CONSULTANT COSTS					
EQUIPMENT					
SUPPLIES					
TRAVEL	DOMESTIC				
	NON-DOMESTIC				
OTHER EXPENSES					
TOTAL DIRECT COSTS FOR EACH BUDGET PERIOD		\$	\$	\$	\$
TOTAL INDIRECT COSTS FOR EACH BUDGET PERIOD		\$	\$	\$	\$
TOTAL DIRECT + INDIRECT COSTS FOR EACH BUDGET PERIOD		\$	\$	\$	\$
TOTAL DIRECT + INDIRECT COSTS FOR ENTIRE PROJECT					\$

JUSTIFICATION FOR UNUSUAL EXPENSES (Detail Justification in Cost Section of Proposal)

CERTIFICATION REGARDING DRUG-FREE WORKPLACE REQUIREMENTS

certification is required by the regulations implementing the Drug-Free Workplace Act of 1988, 34 CFR Part 85, Subpart F. The regulations published in the January 31, 1989 Federal Register, require certification by grantees, prior to award, that they will maintain a drug-free workplace. Certification set out below is a material representation of fact upon which reliance will be placed when the agency determines to award the grant. Certification or violation of the certification shall be grounds for suspension of payments, suspension or termination of grants, or government suspension or debarment (see 34 CFR Part 85, Sections 85.615 and 85.620).

GRANTEES OTHER THAN INDIVIDUALS

The grantee certifies that it will provide a drug-free workplace by:

- (a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;
- (b) Establishing a drug-free awareness program to inform employees about --
 - (1) The dangers of drug abuse in the workplace;
 - (2) The grantee's policy of maintaining a drug-free workplace;
 - (3) Any available drug counseling, rehabilitation, and employee assistance programs; and
 - (4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;
- (c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);
- (d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will
 - (1) Abide by the terms of the statement; and
 - (2) Notify the employer of any criminal drug statute conviction for a violation occurring in the workplace no later than five days after such conviction;
- (e) Notifying the agency within ten days after receiving notice under subparagraph (d) (2) from an employee or otherwise receiving actual notice of such conviction;
- (f) Taking one of the following actions, within 30 days of receiving notice under subparagraph (d) (2), with respect to any employee who so convicted --
 - (1) Taking appropriate personnel action against such an employee, up to and including termination; or
 - (2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purpose by a Federal, State, or Local health, Law enforcement, or other appropriate agency;
- (g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), (c), (d), (e), and (f).

The grantee shall insert in the space provided below the site(s) for the performance or work done in connection with the specific grant:
 Office of Performance (Street address, city, county, state, zip code)

: ____ if there are workplaces on file that are not identified here.

GRANTEES WHO ARE INDIVIDUALS

Grantee certifies that, as a condition of the grant, he or she will not engage in the unlawful manufacture, distribution, dispensing, possession or use of a controlled substance in conducting any activity with the grant.

Signature Name

AO or NRA Number and Title

Signature and Title of Authorized Representative

Signature

Date

Signature of Principal Investigator Name

Proposal Title

**CERTIFICATION REGARDING
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS
PRIMARY COVERED TRANSACTIONS**

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 34 CFR Part 85, Section 85.510, Participants' responsibilities. The regulations were published as Part VII of the May 28, 1988 Federal Register (pages 19160-19211). Copies of the regulations may be obtained by contacting the U.S. Department of Education, Grants and Contracts Service, 400 Maryland Avenue, S.W. (Room 3633 GSA Regional Office Building No. 3), Washington, D.C. 20202-4725, telephone (202) 732-2505.

A. The applicant certifies that it and its principals:

- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
- (b) Have not within a three-year period preceding this application been convicted or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
- (c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph A.(b) of this certification; and
- (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default; and

B. Where the applicant is unable to certify to any of the statements in this certification, he or she shall attach an explanation to this application.

C. Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lowered Tier Covered Transactions (Subgrants or Subcontracts)

- (a) The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principles is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any federal department of agency.
- (b) Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

Organization Name

AO or NRA Number and Title

Printed Name and Title of Authorized Representative

Signature

Date

Printed Principal Investigator Name

Proposal Title

**CERTIFICATION REGARDING
LOBBYING**

As required by S 1352 Title 31 of the U.S. Code for persons entering into a grant or cooperative agreement over \$100,000, the applicant certifies that:

- (a) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, in connection with making of any Federal grant, the entering into of any cooperative, and the extension, continuation, renewal, amendment, or modification of any Federal grant or cooperative agreement;
- (b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting an officer or employee of any agency, Member of Congress, an or an employee of a Member of Congress in connection with this Federal grant or cooperative agreement, the undersigned shall complete Standard Form - LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.
- (c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subgrants, contracts under grants and cooperative agreements, and subcontracts), and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by S1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

Organization Name

AO or NRA Number and title

Printed Name and Title of Authorized Representative

Signature

Date

Printed Principal Investigator Name

Proposal Title